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WAKE UP, AMERICA! MANUFACTURING METHODS WHICH IMPERIL OUR TRADE.

By Louis Bell.

It is almost exactly ten years since THE ENGINEERING MAGAZINE laid down the first clear definitions of that system of manufacturing which has come to be known as distinctively American. During the entire intervening period, these pages have been the repository of the leading literature of the subject—of the classics in the science of engineering as applied to mechanical production. We have numbered among our contributors most of the great specialists in the practice of "Production Engineering"—the modern profession based upon this highly modern literature—and the fundamental principles of systematized, specialized, standardized, and repetitive manufacture have been set forth more fully and lucidly here than anywhere else.

We should not be true to our course or our calling if we did not examine fully the bounds of these methods, and seek to show the limits of their power and range, as well as to exploit the regions in which they have undoubted sway. Indeed, the question as to these limits and the present relation of the American manufacturer to them is asked now by so many earnest voices that it should not go unanswered. We know no one who can speak to it more earnestly, more sympathetically, or more fearlessly than Dr. Bell. We commend his article to everyone interested in the manufacture or use of engineering appliances, as a leading contribution to the newer literature of production—a literature which shall be broader, stronger, more fully recognizant of all conditions and influences, even, than the old.—THE EDITORS.

SO wonderful has been the growth of American manufactures, and so sensational the resulting increase of wealth, that it seems almost ungrateful to suggest even the remote possibility of disaster; yet for some years past our more far-seeing economists have realized that there are dangers ahead. The immense resourcefulness of the American spirit has thus far won out, but each year foreign manufacturers are learning more from methods and applying what is best in them with remarkable shrewdness. So as time goes on we hear more and more frequently of the "German Peril" or the "Belgian Peril," or what not, which really means, without regard to nationality, a challenge to the industrial supremacy which we are striving to maintain.

Now, broadly, competition is a struggle of intelligence, of quick perception and adaptibility, of far-sighted appreciation of the world's wants. But unless the knowledge thus gained is diligently applied it will sooner or later fail of results. Just at this point lies the chief danger to American industry. The foreign peril lies not in foreign acuteness, but in the painstaking avoidance of our mistakes. Our real danger is not from without, but from within—the danger that comes from over-haste and lack of thoroughness.

These things are just as characteristic of American industry as is the marvellous alertness that has been its motive power. In the mechanical arts, for instance, American methods and workmen produce average results of remarkable excellence; but if one wants a bit of work done with the utmost thoroughness and precision, nineteen times out of twenty he will find that the workman who has finished it is a German or Swede or Englishman—if indeed he is able to get it done at all. As every thoughtful manufacturer fully realizes, there is a dearth of skilled labor, and native American skilled labor is the rarest kind. As a result the finest artisans in many lines of work are not to be found in this country, and the goods which they produce are imported.

If these conditions applied merely to a few articles of extraordinary character they would furnish no cause for anxiety, but as time goes on the list of high-grade importations lengthens ominously.

The fact is usually put lightly aside with animadversions concerning foreign pauper labor. American skilled labor is indeed relatively well paid, and the protective tariff is in theory supposed to take account of this fact. If, however, one examines the importations of fine mechanical goods it very quickly appears that they are brought in and sold as against native products, in spite of duties large enough not only to cover the difference in labor cost, but a large margin beyond it. In other words, the United States each year imports to the extent of many millions of dollars articles which could perfectly well be manufactured in the country and sold at a remunerative figure, did the American industrial system encourage the class of work which they represent.

This system has been sketched often enough in the pages of THE ENGINEERING MAGAZINE for its salient features to be familiar. Its primal intent is to produce, at the lowest possible cost, the largest possible quantity of marketable goods. To this end are subordinated the methods of production and the character of the product. The fundamental principle of the method is to reduce manufacture to operations

by automatic machinery, using human labor only where it cannot be avoided, and constituting a manufacturing plant as a species of enormously complicated machine tool of which the workmen are merely belts, wheels, and oil-cans. The only real artisans are in the draughting room, the pattern shop, the tool shop, and at the inspection benches. Every part of the huge machine, animate and inanimate, is pushed up to its maximum output on the simple principle that its total working capacity during its life is a fixed quantity and the sooner it is worked out the larger will be the yearly product, and the more rapidly will the capital be turned over.

As with the process, so with the product. The cheapest product is a uniform one, and hence all works proceed, as far as possible, upon certain average types representing current average demands, or sometimes merely forms of minimum cost which have to be taken in default of anything better available. If a product can be run off by the mile and sawed up into convenient lengths afterwards, so much the better. As a rule, inspection is merely to determine present marketability—in other words, to avoid obvious "seconds."

Hence average quality is determined not by adherence to any ideals, but by the perfection of the working mechanism. It is mere justice to say that under favorable conditions this average may be extremely high. American watches, firearms, sewing machines, and so forth, have found their way to the uttermost parts of the earth, and for their price cannot be approached in quality—much less surpassed. Up to the point where machines need to be supplemented by a high degree of intelligent skill the American method works magnificently. At this point it becomes self-destructive, and all along the line it suffers more or less from too close adherence to the principle of averages upon which it is founded.

There is a constant tendency toward the production of types modified so as slightly to cheapen construction even at a considerable sacrifice of convenience; or, more serious still, manufacture is cheapened by designs which make repairs and renewals extremely troublesome, on the principle that it is better to scrap the article and buy a new one than to pay a little more for one that can be properly repaired. In similar fashion the high-pressure piece work results in turning out articles just capable of passing hurried inspection, and no more.

Doubtless these tendencies have their origin in the desire of the average public for bargains, nowhere keener than in America. In fact, our chief national foible may be described as the attempt to get an effect of regal magnificence for about $1.37½. Yet our industrial

methods bear in the same direction by making high-grade work relatively very expensive. Anything, in fact, that departs from the established conditions made to suit the average demand, is punished. As an example take the medium-priced American hand camera. It is a marvel of adroit adaptation to the needs of the average purchaser and a really wonderful product for the money, but if one attempts to purchase apparatus of the highest grade it is rather cheaper to import than to buy in America, let alone the fact that most of the finest lenses are imported anyhow. The same condition holds for many other lines of manufacture. Indeed, certain classes of goods are practically unknown in American trade, and it sometimes happens that goods which would hardly pass inspection abroad are unloaded here as quite good enough for a people that is content with the cheap and tolerable.

Stern adherence to the principle of average demand thus leads foreigners to the opinion not altogether helpful to American trade, that American products are inherently second-rate—good second-rate, to be sure, but still much inferior to the best. This is actually untrue in the last analysis, but it has this much in its justification, that the American manufacturer does not find the largest profits in the limited demand for the highest classes of workmanship.

On the other hand, in very cheap goods—far below the average standard American plane—the foreigner sometimes beats us at our own game. The cheap Belgian gun, for instance, comes to this country, duty paid, at a price that staggers native production. The European is learning American methods, and with the advantage of cheap labor it is only a question of time before he can bring standard workmanship up to the American plane.

Our industrial organization, too, is such as to aggravate still further the evils which follow in the train of standardized output based on average demand. Of late years there has been a general movement toward large capitalization, based neither on investment nor conservative earning capacity, but on the estimated profits of a period of exceptional prosperity. As a result, work managers are often hard-pressed to keep up with the pace set by the financiers, and must strain every nerve to keep the product at its point of maximum profit by holding close to the cheapest lines of operation. Anything that yields less than the average profit is discouraged or abandoned, and new lines which may in their development cause a change of standard types are looked upon with aversion. The perennial question asked by the sales manager who sits next the financial throne is not : "Are we pushing ahead with the production to meet the inevitable trend

of progress?" but "What line have you got to drop to get out those twelve million pieces of Type Q, No. 61, that our salesmen can unload before our fiscal year ends?" There is barely a foreman from Seattle to Tampa and San Diego to Eastport who will not recognize the sentiment, if not the phraseology.

Now right here lies the most imminent peril to American industrial supremacy. It has been won through long years of keen initiative of inventive genius, of resourceful improvement in methods. With a high cost of labor against him, the American manufacturer has kept ahead of the game by acting upon his foresight and keeping his methods in advance of all competition. A very few years of stagnant standardization and profit-taking will forfeit the hard-won lead and put the foreign competitor to the front. Already in certain lines it is perfectly evident that the improvements are being made abroad, and that they can be kept out of competition only by a high tariff, which at this particular time can hardly be considered a permanent reliance. It is a short-sighted policy that makes a period of great prosperity relatively unproductive in improvements. Worse than this, the greed for increased output is so great that production tends toward carelessness, and channels for competition are opened, never to be closed. For example, I know of several automobile works in which the forgings are largely imported from Germany in spite of the tariff. Experience has shown that the foreign product has a uniformity in properties very difficult to secure here, and that the parts are forged so closely to gauge that the saving in labor is enough practically to counterbalance the duty. Similar conditions appear in various other industries from time to time. The tendencies of the current policy appear most seriously in American export trade. Goods of types standardized for domestic trade do not always or often meet the requirements of, for instance, the South American markets, and the increasing demands of those countries are therefore filled through other channels held to less rigid bounds. At the present moment most American industries are behind their orders and do not worry about additional sales abroad; but some day in the not distant future these markets will be badly needed and can be won only at heavy cost, if at all. The trouble here, too, is not only with the products, but with the absolute indifference to commercial requirements. The whole tendency of our modern industrial machine is toward inflexibility and this extends to the methods of distribution as well. Foreign red-tape makes requirements which seem often unreasonable, but foreign business goes to the exporter who respects them. The American is too apt

to treat them with lofty contempt, and suffers accordingly. Painstaking courtesy in meeting the possibly peculiar requirements of a foreign customer is a lesson that many American firms need sadly to learn. Every consignee won over by polite consideration is a self-appointed advertising agent whose services are extremely valuable.

This inflexibility and the system of production which it induces leads directly to the labor troubles which steadily increase in number and severity. As machinery has been perfected and the works has become a huge machine tool, so the workman has become less an individual. He rarely has a trade or even a legitimate calling, but rather the undivided *nth* of a trade and the vague fragment of a calling. Almost necessarily he ceases to be resourceful, and if thrown out of work becomes a recruit in the great army of the unemployed, enlisted there until an exactly similar job turns up.

The present situation is one that involves great and rapid changes in opportunities for work. There is no longer the flexibility that comes from the existence of trades, or anything like stability of production. It is no uncommon thing for branch works to shut down permanently to allow the centralization of a standardized manufacture, or for the output to be suddenly diminished to relieve over-production, in either case throwing out of employment a large force of men unfitted to take care of themselves. Hence they are the more apt to make unreasonable demands when they see production at a pace that forbids a lock-out. It is David Harum's motto: "Do unto others as they would do unto you, and do it fust." One cannot expect to find stability in the employed when there is no stability in the employment. As a matter of fact, it is very doubtful whether the total earnings of the average American workman over a period of fifteen or twenty years are materially greater than those of his foreign competitor, taking into account the difference in cost of living. Instability of employment, common in all lines and a recognized feature of many, goes far to compensate for the nominally greater wages of the American. The consequent feeling of insecurity is a demoralizing influence the seriousness of which it is hard to overestimate.

Of course there is no doubt about the temporary economy of the American system. To make an unlimited quality of a certain fixed line of articles, at a pace quickened or slackened as the sales rise and fall; to keep up the speed of the workmen by gradually dropping the price of piece work; to sell on long deliveries and short time—all these things keep capital moving rapidly and help pay the dividends.

Whether in long periods the same economy is shown and will be shown, is open to grave question. So long as a country is growing rapidly and can absorb goods and money and men rapidly, the present methods of manufacture can be expected to answer the purpose. In the day when there is greater stability in conditions and keener actual competition, natural selection will get to work and standardized mediocrity will not be among the fittest to survive. It is unsafe to reckon upon the indefinite continuance of combinations able to control supply and demand and to furnish what they will at whatever price they desire. Only the blind in spirit can fail to see the handwriting on the wall. Under normal industrial conditions enterprise and progressive anticipation of the world's needs can be counted upon to win over methods that depend absolutely upon an unlimited market, or complete control of it, to maintain profits.

Specialized manufacture will always have place in the world's work. The production of fixed types will inevitably be successful so long as these types are in demand, since a fixed product is cheaper than one often varied. Yet types of manufactured products rarely have a long life. Improvements are constantly made, and the old is superseded by the new. Standardization, however desirable from a pecuniary standpoint, in the last resort means the cessation of active improvement. In relatively fixed arts standard products may hold their own for many years, as in the case of certain textiles. In the mechanical arts, however, there is constant change by which the world has marched onwards, and even a brief halt may mean falling out of the ranks.

It is for this reason that the present note of warning is sounded. It is emphatically true that in very many lines of industry in our country active improvement has been checked in the interest of profit-taking. In the long run the effect of this is bound to be disastrous to American progress. There are signs even now of foreign competition based on an active campaign of improvements. In not a few of the engineering trades we are in this country copying European products instead of compelling them to copy ours, as of yore. Meanwhile the average quality of American labor is running down, owing to the practical abolition of integral trades, and it will be progressively harder to obtain the skill needful as the basis of improvement. Every great works feels the scarcity of skilled craftsmen, and the worst of the matter is that such have small incentive to existence in the face of the uncertainty of employment due to the general labor difficulties. When the rank and file of the workers strike, or the works are shut

down on account of the latest merger, lumpers and skilled mechanics alike are idle.

There is a constant feeling of unrest among workmen under American conditions. They know that they are merely parts of a machine which stops and starts, accelerates and slows down, from causes absolutely beyond their control, and that each year they must take the chances of being displaced by cheaper men if such can be found available for filling the oil-cups.

Industrial conditions can probably never be restored to earlier forms. Labor-saving machinery, interchangeable parts, and systematized production, have their due place to fill in the world's economy. But they need not become, as they are becoming just at the present time, an excuse for stagnation. They should be the source of manifold lines of progress and be employed in working out new ideas instead of perpetuating old ones. And above all, they should not be allowed to check the development of the craftsman who is necessary to the perpetuation of industry. The greatest industrial problem today is to maintain the supply of active, intelligent, resourceful American labor in spite of the American system.

PATENTS AS A FACTOR IN A MANUFACTURING BUSINESS.

I. THEIR INFLUENCE IN MAKING MARKETS AND COMMANDING SUCCESS.

By Edwin J. Prindle, of the New York Bar.

The great fortunes won from patented inventions are before everyone's eyes. Rich opportunities of like kind may be lying near at hand, unrealized and undeveloped because of ignorance that they can be patented and given an immense market value, and further ignorance of the steps necessary to that end.

Mr. Prindle is a practical mechanical engineer, as well as a patent lawyer who has had entire charge of patenting, litigating, and successfully establishing some well-known recent inventions. He does not undertake, in the series of articles here begun, to make every manufacturer his own patent lawyer. He does, however, point out a whole range of hitherto generally unrecognized possibilities for profitable patents. He points out many important bearings they may have in the shop, in relations with employees, and in the sales office. He suggests many chances for pre-empting new markets or entering desirable ones. And in view of the international range of all large modern patent practice, his articles will have wide application.—THE EDITORS.

PATENTS have been one of the most important factors in the growth of the United States from a group of poverty-stricken, non-manufacturing dependencies to the greatest manufacturing country in the world. In fact the late Senator O. H. Platt of Connecticut, one of the profoundest minds in the United States Senate for the past thirty years, maintained that the American patent system has been the greatest factor in the material development of the nation.

Patents are the best and most effective means of controlling competition. They occasionally give absolute command of the market, enabling their owner to name the price without regard to cost of production, as for example where they cover all known forms of devices for accomplishing a given purpose. There are a number of great companies whose position commercially is, or has been, due almost wholly to the possession of controlling patents.

Among such corporations are the Bell Telephone Company, which, while it does not now depend largely upon its patents, was able to control the situation absolutely for many years, and to get itself so well located that it now has a practical monopoly in many cities, because of its being the first to occupy the field. The United Shoe Machinery Company is today in control of the manufacture and sale, or licensing, of the bulk of shoe-making machines, because of its

patents; and this control, although several serious attempts to break it have been made by concerns heavily backed with money, the owners of the patents have been able to maintain. Ninety per cent of the welt shoes made in the United States are sewed upon machines which the United Shoe Machinery Company has been able to protect by means of its patents. The Westinghouse Air Brake Company built itself up on patents. Patents have played an important part in the development of the Westinghouse Electric Company and the General Electric Company. They have indeed become so well recognized a factor in commerce that these concerns, and many others, keep a large corps of inventors at work with a view constantly to improve their product so that they will be able to offer a product that is at least slightly better than that of their competitors, and which is so protected by patents that they do not have to compete with an article of equal merit. The time when the patents on their present products will expire is constantly kept in view, and they endeavor to have new ideas, similarly protected and ready to put on the market when the patents under which they are at present working shall have expired.

The reader will be able to recall many devices and processes which are now, or until recently have been, entirely within the control of a single concern. Take, for instance, the most successful forms of any of the following devices: the air brake, the cash-register, the steel car, the most popular stopper for beer bottles, the form of shoe-lasting machine most in use, the process of making the best armor plate, the commercial process of making calcium carbide, from which acetylene gas is generated, as well as the commercial form of the carbide itself; the incandescent gas-lamp, the phonograph and the graphophone. Even if a patent covers only the single feature of a device which makes it commercially the most desirable of its kind, still such a patent, so far as holding the market at the old price is concerned, often gives a complete monopoly. A patent covering a process or a machine for making a staple article, which process or machine effects such a saving in the cost of production as to enable its owner to undersell all others at a fair profit to himself, is as valuable, while that condition lasts, as a patent on the article itself, for the effect is to give him control of the market.

Patents are the only legal form of absolute monopoly. And they are absolute so far as they go. In a recent decision the court said:

> "Within his domain, the patentee is czar. The people must take the invention on the terms he dictates or let it alone for seventeen years. This is a necessity from the nature of the grant. Cries of restraint of trade and impairment of the freedom of sales are unavailing, because for the promotion of the useful arts the constitution and statutes authorize this very monopoly."

The possession of suitable patents is, therefore, of great importance to the manufacturer. On the other hand, it is equally important to the manufacturer whose competitor has patents, to understand what limitations, if any, there are to his competitor's advantage, and how, if at all, a counter-advantage may be gained.

Having shown from this brief sketch the importance of the subject, the purpose and scope of the article may thus be stated:

I have found, in my practice of the law, that many—in fact most—owners of patents and of patentable inventions do not fully understand what their rights are under their patents; what, for instance, can be accomplished by means of them; how they can be bought and sold; how, while getting all the benefit possible in their own arts, those who own patents can sometimes make money out of their patents by permitting others to use the invention in other and non-competing arts; to whom an invention belongs that is worked out by an employee; how to protect one's self from being supplanted by improvements made by one's own employees; how to prevent a manufacturer's product from being used in a way not intended, or sold at a price below that desired by the patent owner.

While I do not aim to make the manufacturer his own lawyer, I do wish to open his eyes to what it is possible to do in connection with patents, not for the purpose of his doing it unguided by legal advice, but of suggesting to him to what ends to ask such advice. There are many manufacturers who could and would strengthen their position commercially through patents, if they but saw the neglected material at hand, or understood the fuller possibilities of material, of the availability of which they are already partially aware.

The Subjects of Patents.

And first of the subjects of patents: There are four classes of inventions for which patents are granted, viz, arts, machines, manufactures and compositions of matter. It is not intended to give exact definitions of these classes of inventions, but merely to illustrate their scope, so that a manufacturer may be led to inquire whether or not an invention that falls under his control is patentable. My observation has been that the mistake is often made of failing to patent inventions which might have been patented, but which the layman decided for himself were not patentable.

With this explanation, I may say, that an art may be any process, or series of steps or operations, for accomplishing a physical or chemical result. As examples may be mentioned: the art of telephoning by causing undulations of the electric current corresponding to

the sound waves of the spoken voice; or of casting car wheels, which consists in causing a jet of molten metal to enter the mold in a tangential direction to give the metal a whirling motion, so that the heavy sound metal will flow to the rim of the wheel and the cinders and bubbles will thus not occur on the rim. The patentability of a process does not depend on the apparatus with which it is carried out. The apparatus may be old, and the process may consist in a new way of using an old apparatus. The fact that no new mechanism may be required in practicing the process is apt to mislead the manufacturer into thinking there is no patentable invention present. In the case of the process of casting car wheels, the same old mold and ladle could be used, and the invention consisted in holding the ladle so that the metal would strike the mold tangentially and thus get whirling motion in the mold, instead of simply pouring the metal straight in, which would mix the cinders, bubbles, and sound metal together.

A manufacture is anything made by the hand of man that is not an art, machine, manufacture, or composition of matter. A safety pin, a tooth brush, and a whistle are all articles of manufacture.

A machine is any assemblage of mechanical elements having a law of action of its own. A steam engine and a jack knife are both machines. The distinction between an article of manufacture and a machine is not important.

A composition of matter is any mixture or combination of chemical elements, whether solid, liquid, or gaseous; such as calcium carbide, from which acetylene is made, acetylene itself, a soap, or a tool steel.

A new combination of old elements may be patentable, if it produces a new or improved result, or an old result in a new way. A combination of elements may be patentable as a whole, and some of its sub-combinations may be patentable. A new form of an element of a combination that is old as a whole may be patentable. Improvements and attachments on old machines may be patentable. A new use of an old device or machine or process may be patentable, if the new use is so different from the old use as not to be obvious to an ordinary skilled workman in the art. In such a case, and with all subjects of patents, the courts require that the alleged invention or discovery be one that is not obvious to the ordinary skilled workman in the particular art, and they hold it must be so far from obvious as to require the exercise of the inventive faculty. There is no rule by which all cases can be judged, but each case is decided on its own merits. If an invention has long been sought for without success, the

courts will usually sustain the patent, no matter how obvious the invention appears after it has been disclosed.

The Nature of a Patent.

A patent is a public grant, in the nature of a contract between the government and the inventor. The inventor on his part is required to disclose fully a new and useful invention or discovery which he has made himself. If the invention is not new to the public at the time the inventor makes his invention, then the inventor has given nothing to the public which it did not already have; if the inventor has kept back some essential part of the invention, so that he has not fully put the public into possession of a knowledge of the invention; if the invention is not operative, or is injurious to the public health or morals, so that it is not useful; if the patentee did not invent or discover the invention, but learned of it from others—then in all these cases he has not given the public a proper consideration for the patent, and the patent is invalid.

The law also requires that the invention shall not have been described in a printed publication or have been in public use or on sale for more than two years before the inventor filed his application.

A patent consists of a deed, signed and sealed by the Commissioner of Patents, granting to the inventor the exclusive right for seventeen years to make, use, and sell the invention, and referring to the attached specifications and drawings (if there be drawings) for a disclosure and definition of the invention.

The grant of a patent purports, as just stated, to give the inventor the right to make, use, and sell the invention; but in legal effect it really gives him only the exclusive right to prevent others from making, using, and selling the invention. If his invention happens to embody the principle of some invention that is covered by a previous patent, the owner of the previous patent can prevent the making, using, and selling of any embodiment of the later invention using the earlier principle, and the later patentee must either make terms with the earlier patentee or wait until the earlier patent is dead. But the later patentee can prevent the earlier patentee or anyone else from using the later invention during the life of the later patent.

The Claim of a Patent.

As some, and even the greater part, of the machine or other device shown in a patent may be old and not patentable, and the part invented by the patentee may be, and usually is, less than the whole, the patentee is required to state in terms just what his invention consists in, and such a statement or statements are called "claims." They are

the measure of the grant, the latter (but for the name of the patentee and the title of the invention) being the same in all patents. There is no piece of English composition that is more generally misunderstood than the claim of a patent. But the general nature of a claim (which is all I propose in this paper to treat) is not beyond the comprehension of the layman.

A claim is not a statement of advantages of the invention, but it is a more or less precise technical description of the invention. A strange thing about a claim is, that the more it says, the less it means. As a specific example: suppose John Doe invented a turret lathe, consisting of a bed having a head-stock on one end, a spindle journalled in the head-stock and a chuck on the spindle, a slide mounted on ways on the bed, a turret on the slide, a series of tools in the turret, a rack on the slide engaged by a pinion on the bed, and a hand wheel for turning the pinion, so that the slide and turret could be advanced to cause each tool to engage the work. His claim might read as follows:

"I claim a machine tool consisting of the combination of a bed having ways, a head-stock on said bed, a spindle journalled in said head-stock, a chuck on said spindle, a slide mounted on said ways, a turret revolubly mounted on said slide, a series of tools mounted in said turret, a rack on said slide, a pinion journalled on said bed and engaging said rack, and a hand-wheel for turning said pinion, whereby a piece of work may be secured in and revolved by said chuck, whereby said turret and tools may be advanced against and retracted from the work, and whereby said turret may be turned to bring its various tools into cutting position."

Now suppose Doe's turret lathe was the first machine ever invented in which the work was revolved, and a tool mechanically held on a slide was moved against the work. The principle of his invention, stated that broadly, is found in a lathe without a turret; in a boring mill; in a pipe-threading or cutting machine, and other machines; and under the supposition that his was the first machine to move a tool mechanically against a mechanically-revolved piece of work, all of these other enumerated machines are supposed to have been invented after his machine. But they are not described by his claim; because, for instance, they do not have the turret with its series of tools. So the courts would hold that they were not his invention as stated in his claim. And yet they all manifestly use his principle of mechanically revolving the work, and moving a mechanically-held tool against the work.

The courts will not allow a patentee who states in his claim that

his invention consists of the combination of five elements, to claim infringement by a machine that has only four of those elements, and has no equivalent of the fifth element. While they will imply or read an element into a claim from the specification, if such element is necessary to make the combination stated in the claim complete and operative, and thus save the claim from being void, they will never read an element out of a claim. So, although the claim above is a fairly good word-picture of the machine which embodies Doe's invention, it is evident it does not protect the principle or essence of the invention.

Suppose, now, the claim read as follows:

"I claim a machine consisting of the combination of a frame, means mounted on said frame for revolving a piece of work, guides on said frame and extending toward the position of the work, a part mounted in said guides, a tool on said part, and means for moving said part to carry the tool against the work."

This claim is just as true a description of the Doe lathe, so far as it goes, as was the first claim, and yet it is an equally true description of a lathe without a turret, of a boring mill, and of a pipe-cutting or a pipe-threading machine. So that Doe could justly claim those machines were within his monopoly and that they could not be made, used, or sold without his consent while his patent was in force.

The popular idea is that the more complete a description a claim is of the particular embodiment of the invention shown in the patent, the better claim it is; but the example of the Doe claims shows the fallacy of this idea. It is as though the claim were a bill of sale giving title to cattle on a large Texas ranch. If it gave title to "all the short-horn Durham steers having one white fore foot and three red feet," the purchaser would get very few cattle. If, however, the bill of sale gave title to "all the live stock" on the ranch, the purchaser would not only get all the short-horn steers with only one white foot, but he would get all the steers of every description, and all the heifers, bulls, horses, and pigs there might be there.

The mistake arises from supposing the best form of claim to be a detail description of the particular embodiment of the invention shown in the patent, when it should be a description of every class of machines which embodies the principle of the invention, whether or not the details not essential to that principle are copied. In other words, the claim is not a list of elements, whose virtue is greater the larger the number of elements enumerated; but it is a description of a class of combinations of elements, and the fewer elements stated, the larger

the class of machines is likely to be in which that combination of elements is found.

Perhaps another simile may not be amiss. A claim is like giving one the title to everything that can be found that will fit into a box. Now if no particular kind of box were specified, the grantee would have a very valuable monopoly. Everything that would go into a square, or a round box, or an oval box, or into a star-shape box would be his. But if the box were stated to be a round box having a pin set up in the centre of its bottom and extending up to a level with the top of the box, it is evident nothing could be put into the box but round things having a hole through the middle, and the grantee would have a very much less desirable monopoly.

The popular misunderstanding is doubtless due to the fact that, as before stated, the actual language of a patent is a grant of the exclusive right to make, use, and sell the invention, while its legal effect is only a grant of the exclusive right to *prevent others* from making, using, and selling the invention. The language of the patent is to this effect: "John Doe is hereby granted the exclusive right to make, use and sell a machine consisting of the combination of elements A, B, C, etc.," and the longer the list of elements, the larger appears the monopoly granted. The legal effect, however, is: "John Doe is hereby granted the exclusive right to prevent others from making, using or selling any machine consisting of the combination of elements A, B, C, D, etc.," and the longer the list of elements, the fewer machines there will be that will answer the description and come within his monopoly.

The Supreme Court of the United States has said that the claim of a patent is one of the most difficult pieces of English composition to write. It is often thought that the particular wording of a patent is not important, the skill required being in enforcing the patent in court; but it must now be clear that there is great opportunity for skill and foresight in drawing the patent. A well drawn patent may make plain sailing in court, while a poorly drawn patent often has a hole in it through which serious competition can escape.

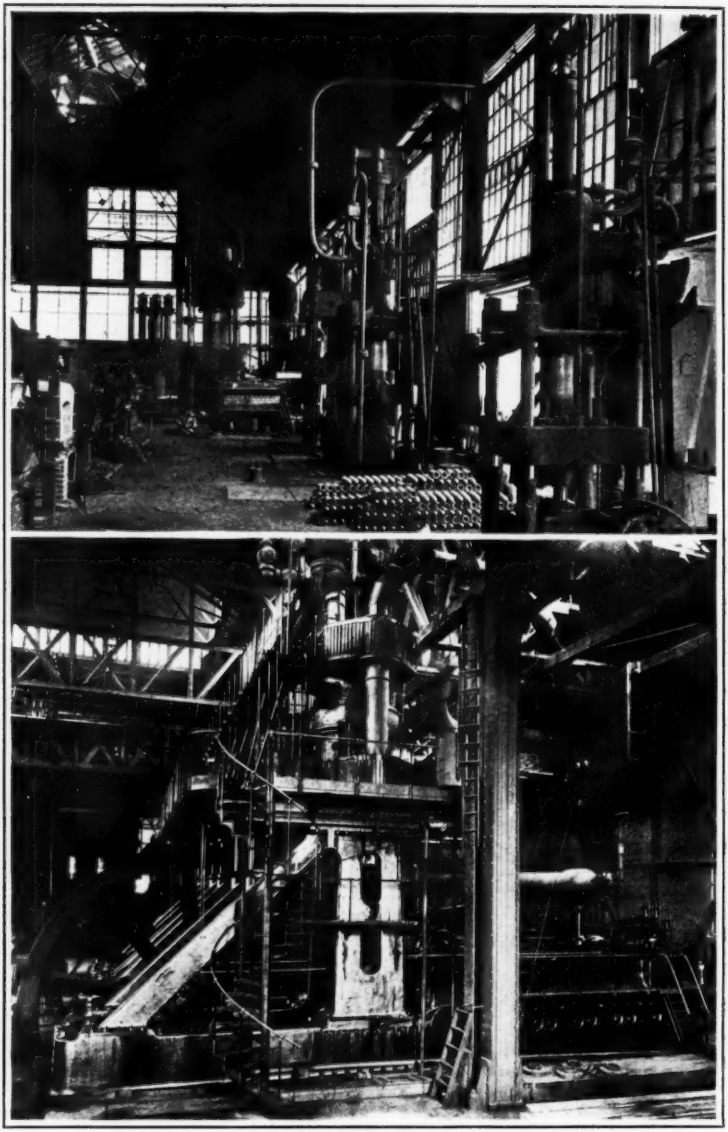
THE MECHANICAL USES OF WATER UNDER PRESSURE.

By Wm. M. Barr.

In two preceding articles, appearing in this Magazine in January and June, 1905, Mr. Barr discussed the "Development of Power Pumping Machinery" and the "Hydraulic Applications of Motive Power"; that is, he dealt with the topic from the point of generation and transmission. Now he takes up possibly the most interesting phase of all—the direct utilization of water pressure in moving machinery, and the principles governing the design of the machines employed. —THE EDITORS.

EACH year brings new requirements in manufacturing industries which call for the use of water in pressure systems. This pressure may vary anywhere from 300 pounds to 1,500 pounds in live loads, and as high as 6,000 pounds per square inch for final pressures. The introduction of hydraulic presses in steel making has led to economies which could not now be dispensed with; the practice of subjecting a mould filled with molten steel to hydraulic pressure is beneficial in expelling the entrained air, and thus preventing the formation of cavities or blow holes in the steel, as well as preventing surface cracks due to tension created in cooling. The amount of pressure to be exerted upon an ingot will depend upon its size, but in any case is rarely less than 1,000 tons. At the Bethlehem Steel Company's Works the capacity of the hydraulic press for the fluid compression of ingots is upwards of 7,000 tons. This method of treatment yields a larger tonnage of commercial product, and of better average quality than had been heretofore obtained.

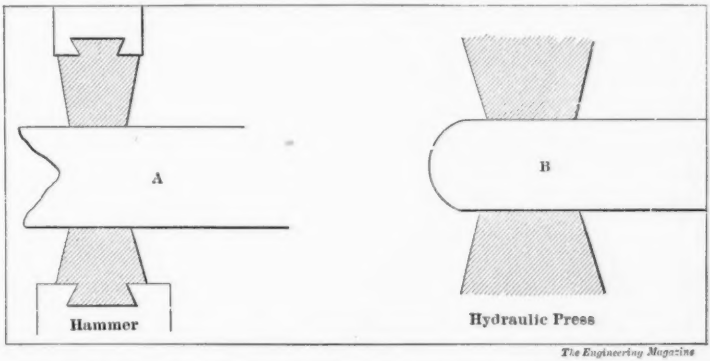
The complete displacement of wrought iron by mild steel in engineering work is practically an accomplished fact. Large masses of wrought iron, such as engine shafts, were not only difficult to forge, but when delivered had a fibrous structure due to contained slag which could not escape during the process of welding. The presence of slag so far reduced the elastic limit of such forgings that 20,000 pounds per square inch was regarded as the practical limit. The adaptation of hydraulic machinery to the work of squeezing steel ingots into such shapes as are required in engineering practice, and especially into large shafts or high-powered ordnance, has had the effect of producing shapes which are not only homogeneous throughout, possessing a much higher elastic limit, though made at less cost.



PART OF THE HYDRAULIC EQUIPMENT OF THE BETHLEHEM STEEL CO.

The upper view is taken in the press shop and shows the hydraulic presses and accumulator The lower one shows the 15,000-horse-power engine furnishing water to the 14,000-ton armor-plate forging press illustrated on page 820. Bethlehem Steel Co., Bethlehem, Pa.

In working thick masses of metal, the flow of the metal is observable at the ends of the ingots, hammer-forging drawing the outside of the ingot beyond the center as in Figure A, whereas the effect of a hydraulic press is shown in Figure B; the difference being that the hydraulic pressure is felt to the center, a flow of metal occurring along the neutral axis of the ingot. Hydraulic forging presses of 5,000 to 15,000-tons capacity are now employed in American steel works, a 14,000-ton press at the Bethlehem Steel Company being served by a 15,000-horse-power pumping engine. It needs but slight knowledge of the subject to understand that for the heavier class of forgings, such as is required for ordnance and marine work, the hydraulic is the only practicable method.



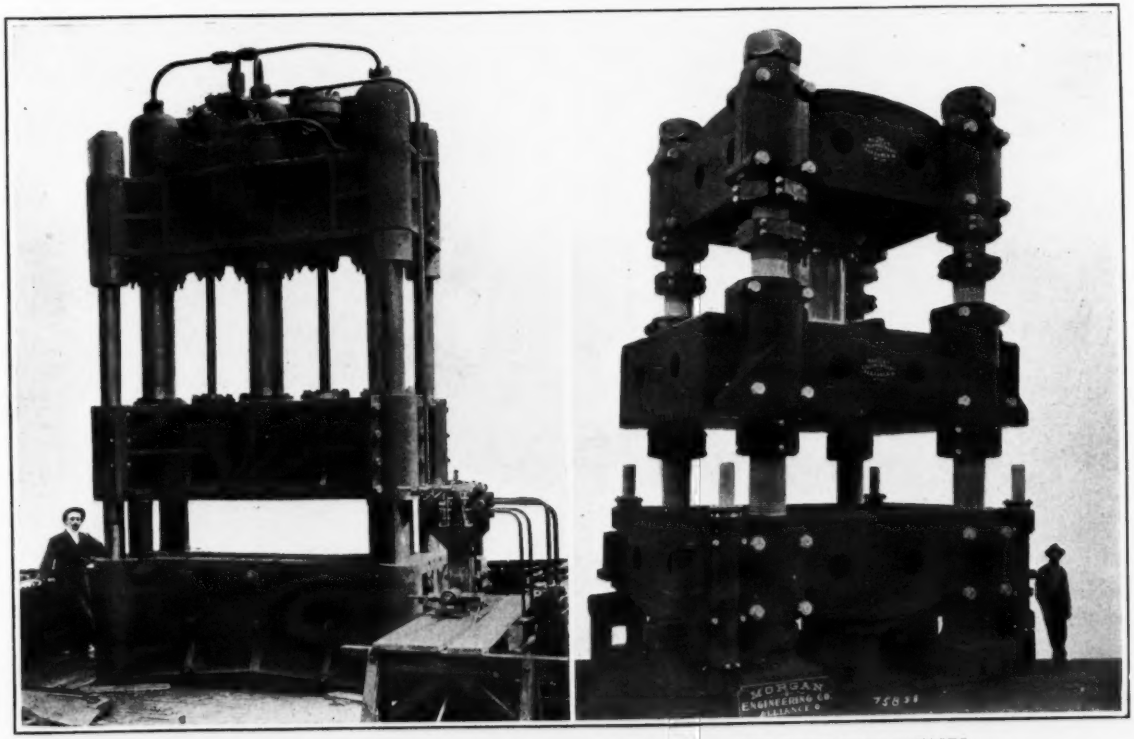
The Engineering Magazine

THE COMPARATIVE EFFECTS OF HAMMER FORGING AND HYDRAULIC PRESSURE.

The effect of such a hammer blow as would be employed in forging a shaft, say 16 to 20 inches in diameter, is confined largely to the surface; that is to say, it would not exceed in any case, one-fourth its diameter, and in all probability much less, the center of the forging remaining, meanwhile, almost wholly undisturbed. In the case of hydraulic squeezing, the element of time is an important one, and the effect of the squeeze is such as to compress the material of the shaft to its center.

Hydraulic plants consist essentially of a pump, an accumulator, and the hydraulic cylinder and ram to be operated upon by pressure. Nearly all hydraulic-pressure pumps are steam-driven. Nearly all are direct-acting pumps; therefore, the highest economies are not to be expected at this end of the installation. Usually pressure is the only thing considered, and, as the action of the accumulator is irregular, and the operation of the pump is automatically controlled by

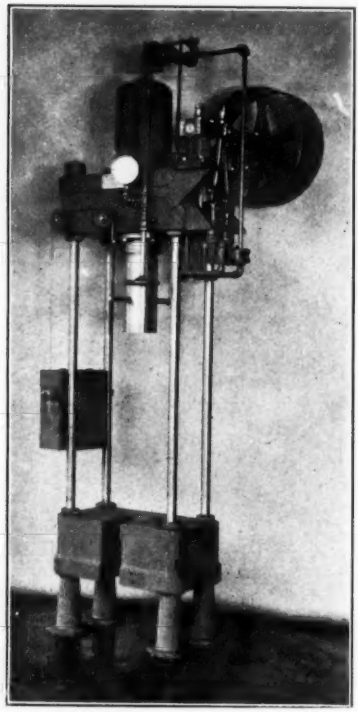
THE 14,000-TON HYDRAULIC ARMOR-FORGING PRESS OF THE BETHLEHEM STEEL COMPANY.



EXAMPLES OF AMERICAN AND OF BRITISH DESIGNS OF 1,000-TON HYDRAULIC PRESSES.

The press on the left, built by the Vauxhall & West Hydraulic Engineering Co., Luton, Bedfordshire, is specially designed for the manufacture of gun-carriage parts and gun shields; quick-acting water-saving valves effect an economy of water and permit a working speed of 30 short strokes a minute. The press on the right, built by the Morgan Engineering Co., Alliance, Ohio, measures 9 ft. by 9 ft., center to center of column bolts, and is equipped with main plunger, lower or clamping plunger, and four push backs.

the movement of the accumulator, the pumps may vary from the highest speed attainable to zero—conditions which are not favorable to the employment of crank and flywheel pumps, unless there are several machines operating from the same delivery pipe line.



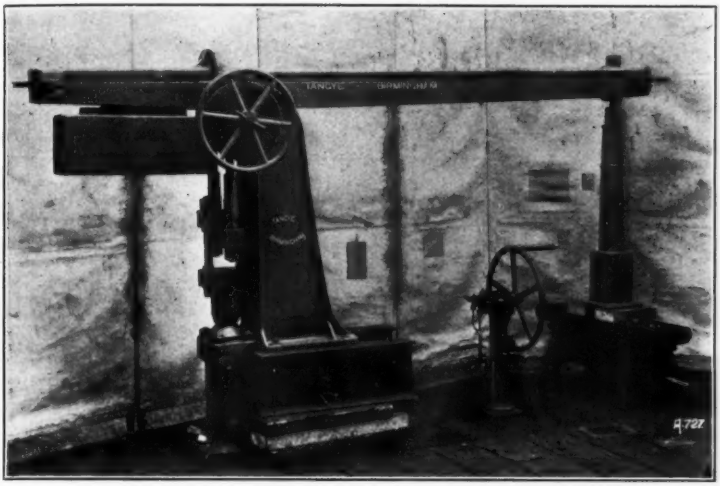
SELF-CONTAINED INVERTED HYDRAULIC PRESS FOR BROACHING PURPOSES.

Available also for riveting up armatures, pressing shafts, etc.; 10-inch ram, 100-ton pressure. Boomer & Boschert Press Co., Syracuse, N. Y.

In designing water ends for such pumps, it must be remembered that water is nearly incompressible, and when it comes in contact with a solid surface, it presses against the surface in a direction directly normal; there can be no such thing as oblique pressure in water when the water is at rest, for oblique pressure means a force partly along the surface, and this would imply some frictional resistance to sliding, which cannot occur in water at rest.

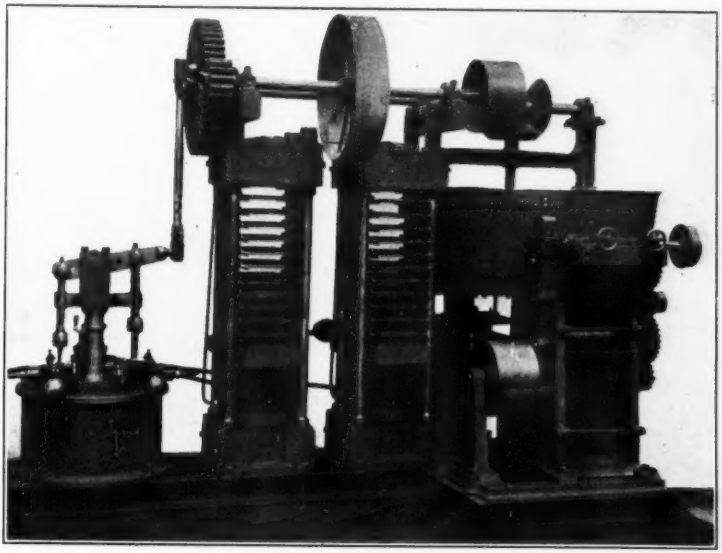
The bursting pressure in a pump cylinder, or in the cylinder of a hydraulic machine, in pounds per square inch, is equal to the tensile strength of the metal in pounds per square inch multiplied by the thickness of the metal in inches, divided by the radius of the cylinder. Water ends made of cast iron usually contain so many hidden defects that with any ordinary working factor of safety they are not really safe when constructed by this rule. For thick cylinders it is difficult to calculate bursting pressures, because the tensile strength is not uniformly distributed over the section at which breakage is likely to occur. For this reason water ends of pumps for high pressures should be made of steel.

Fluid friction need not ordinarily be taken into account in designing hydraulic machinery, because the force of friction depends upon velocity, and is so small at low velocity that it may be wholly disregarded. Also the force of friction does not depend on pres-



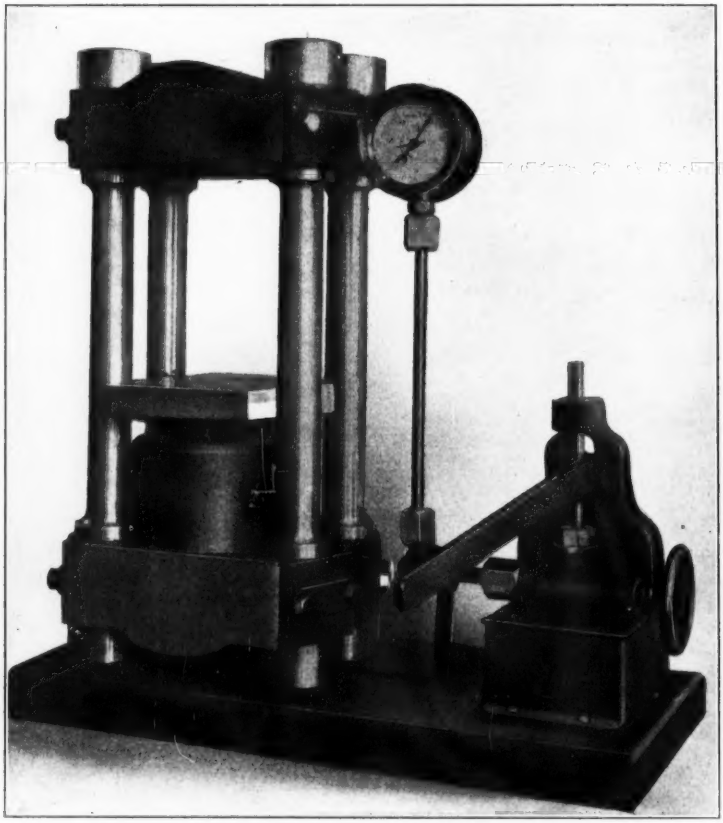
30-TON TENSILE AND COMPRESSION TESTING MACHINE, HYDRAULICALLY OPERATED.

Made for the British War Office, Chemical Research Department, Woolwich Arsenal, by Tangyes, Ltd., Birmingham.



HYDRAULIC PLANT FOR CRUSHING LINSEED, EXPRESSING THE OIL, AND MAKING FEED CAKES.

Musgrove Bros., Leeds, England.

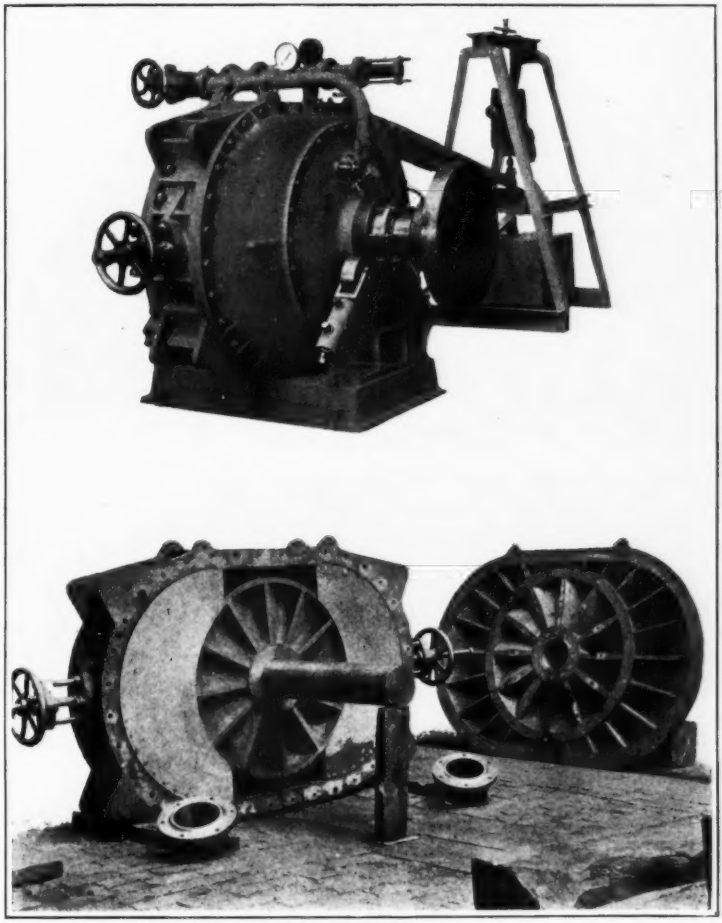


CONCRETE-TESTING MACHINE, CAPACITY 50 TONS IN COMPRESSION.
Ransome Concrete Machinery Co., New York.

sure; it is proportional only to the area of wetted surface, and at moderate speeds does not depend upon the nature of the rubbing surface.

In a hydraulic machine friction must be taken into account, such as that set up between a plunger and a gland, the leather or other packing used in the stuffing box. The friction of solids occurring at the fulcrum of a lever, or that set up between two metal surfaces in contact, must be considered and added to the former. The mechanical advantages of a simple hydraulic machine, leaving friction out of account, depend upon the relative velocities of the plunger and the ram.

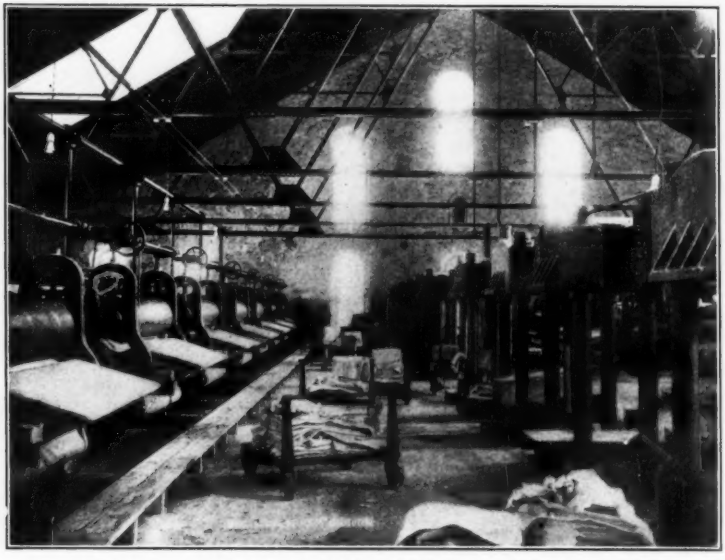
Hydraulic machines having simple pressure cylinders are frequently made of a good quality of cast iron instead of cast steel. Breakage seldom occurs in this part of the mechanism, and when it does, it is not a difficult matter to replace a broken part. Hydraulic wheel presses are bored and commonly lined with copper expanded into place and afterwards carefully burnished. The ram is packed with



WATER DYNAMOMETER FOR TESTING ENGINES OF 1,600 TO 2,000 HORSE POWER AT 250 REVOLUTIONS.

Said to be the largest ever made for the work. Heenan & Froude, Ltd., Worcester, England.

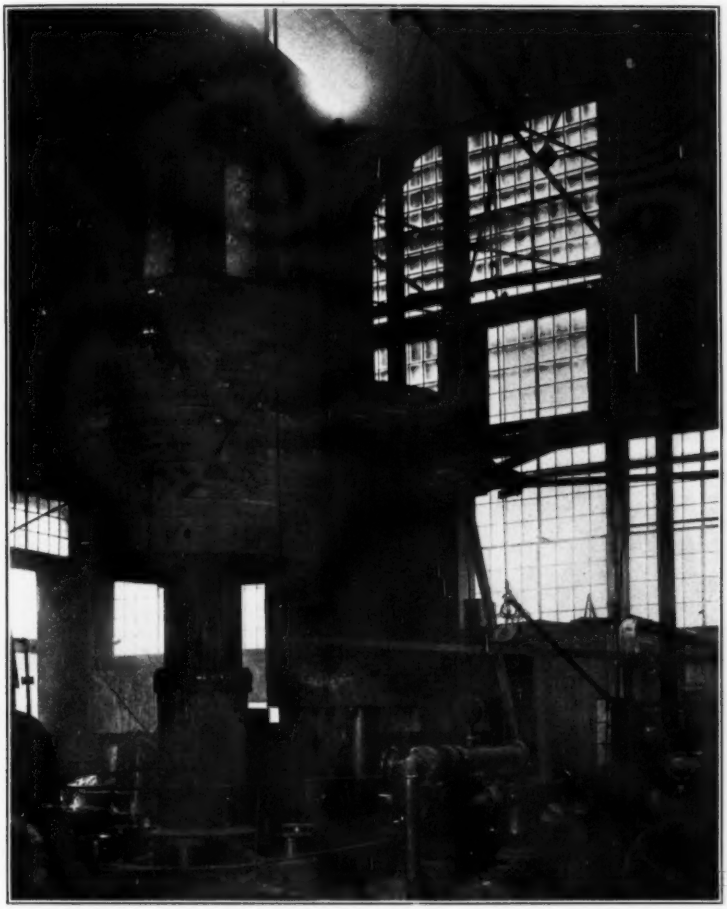
cup leather, making a tight joint under pressure, working with little friction and durable as to wear. Such presses exert 100 to 300 tons total pressure, and are commonly fitted with a double pump to save time in despatching work. Both pumps are operated by a single crank and connecting rod for operating the ram rapidly, or for light pressures, but when the pressure becomes too great for both pumps, the large one may be instantly disconnected without stopping the movement of the ram, which, being thus driven by the small pump alone, goes on with the full power of the machine to the maximum pressure.



INTERIOR OF HYDRAULIC-PRESS ROOM IN A WOOD-PULP MILL.

The presses have rams 18 inches in diameter, with rods of 5½-inch forged steel; their regular working pressure is 450 tons. The water is pressed from the pulp as it comes from the machines to save freight in shipment. Boomer & Boschert Press Co., Syracuse, N.Y.

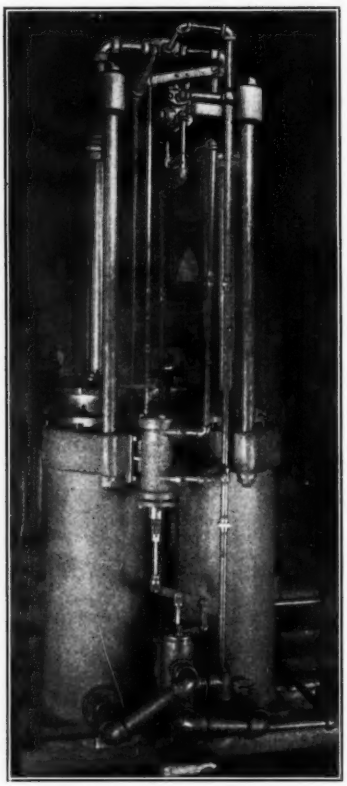
Simple accumulators which consist of a ram carrying a heavy weight are employed for pressures up to 1,500 pounds per square inch. Those having a ram say 3 to 6-inches diameter, consisting of a base plate on which is mounted a vertical pipe with a stuffing box at its upper end into which is fitted a ram with crosshead carrying cast-iron weights, are not only self-supporting but may have as many weights as are necessary for any given pressure. The stroke varies ordinarily from 3 feet for the 3-inch ram to 6 feet for the 6-inch ram.



PRESS SHOP OF THE BETHLEHEM STEEL WORKS, SHOWING ACCUMULATORS AND PRESSURE PUMPS.

Larger accumulators are commonly fitted with a tank attached to the upper end of the ram in which scrap or pig metal is placed until the desired water pressure is secured. In extended systems such as steel works, etc., the pressure varies according to the class of machinery employed; the pressure at the accumulator is seldom below 600 pounds per square inch and not often more than 1,500 pounds.

Varying pressures in hydraulic machines can be had by employing two or more pressure lines, one line having its accumulator weighted

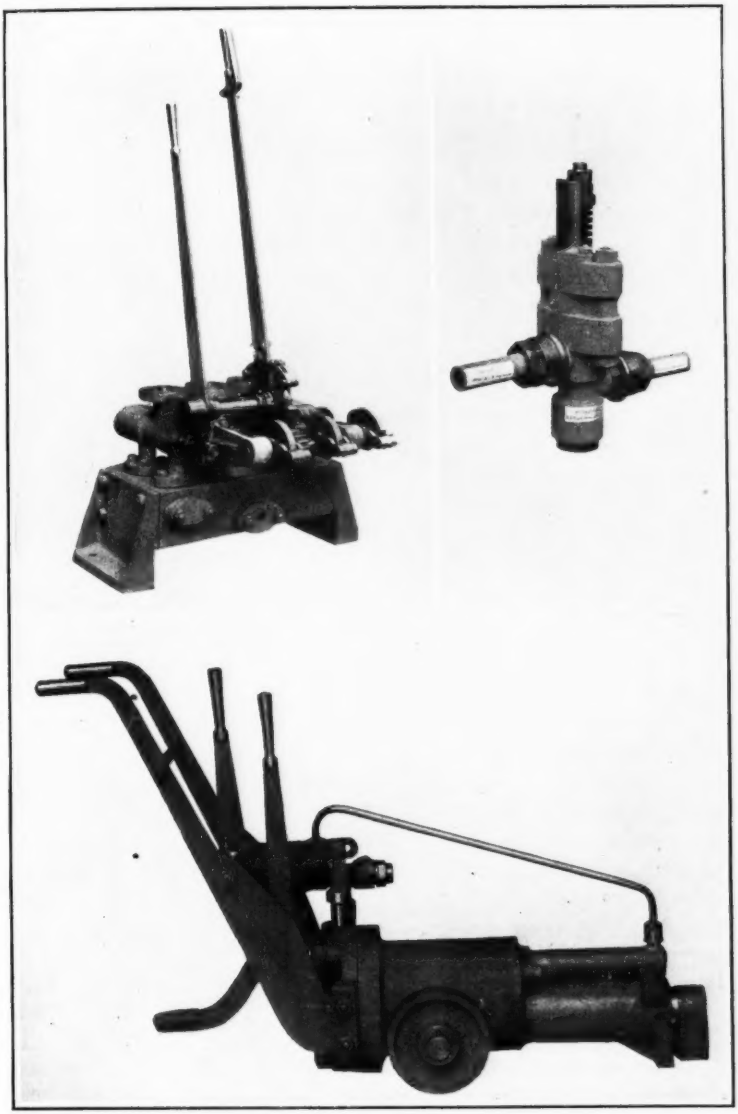


DUPLEX INTENSIFIER.
The Watson-Stillman Company, New York.

for the lowest pressure, the other line having its accumulator weighted for the higher pressure. The latter is applied at the moment when the initial pressure is about completing the movement of the ram. The higher pressure should always be applied before the ram actually stops. No difficulty is experienced in thus changing pressures if a suitable valve is employed, because when the higher pressure is applied, the inlet valve for the lower pressure ceases to lift from its seat, the rise of the accumulator taking care of the water flowing into that particular line from the pump.

In machines operating under two pressures in which the movement of the ram when finishing its stroke is small, a final pressure of several thousand pounds per square inch can be had by means of an intensifier, a machine which consists essentially of a large cylinder fitted with a piston and a small cylinder fitted with a ram corresponding to an ordinary piston rod. The large cylinder, being filled with any fluid under pressure, will exert an increased pressure in the small cylinder corresponding to the difference in areas of the piston and the ram. For example, a cylinder 12-inches diameter with a pressure of 300 pounds per square inch acting upon a second ram of 4-inches diameter would exert a pressure of 2,700 pounds per square inch, this representing the ratio of differences of area into the initial pressure.

An intensifier is sometimes used in connection with a riveting machine, taking the place of a weighted accumulator; in which case the pump delivers into the high-pressure end of the machine, the opposite end being in connection with a steam boiler, city-water main,

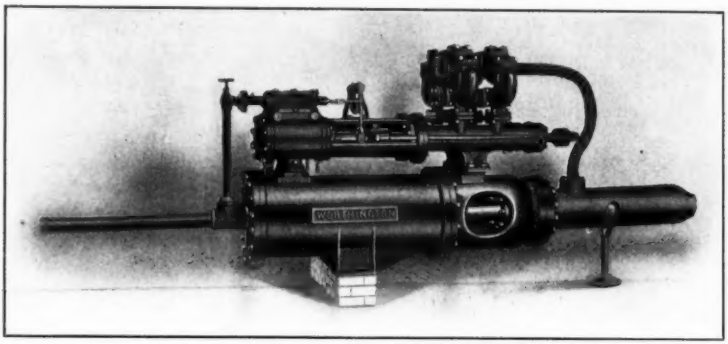


A GROUP OF HYDRAULIC APPLIANCES.

Above on the left is a set of hydraulic actuating valves for a pressure of 3 tons to the square inch. To the right, a hydraulic reducing valve for testing purposes in shops where various pressures are carried. At the bottom is a portable angle-bending machine for use in shipbuilding yards. The Leeds Engineering & Hydraulic Co., Ltd., Leeds, England.

or other constant supply at practically unvarying pressure; this, however, is not the usual practice.

Steam accumulators can be used in connection with a steam pump delivering directly into the cylinder of a hydraulic machine. Suppose a boiler pressure of 100 pounds per square inch and a steam pump delivering water into a hydraulic cylinder at 250 pounds per square inch, pressure enough to do the earlier stages of the work; now by



A WORTHINGTON STEAM ACCUMULATOR.
Henry R. Worthington, New York.

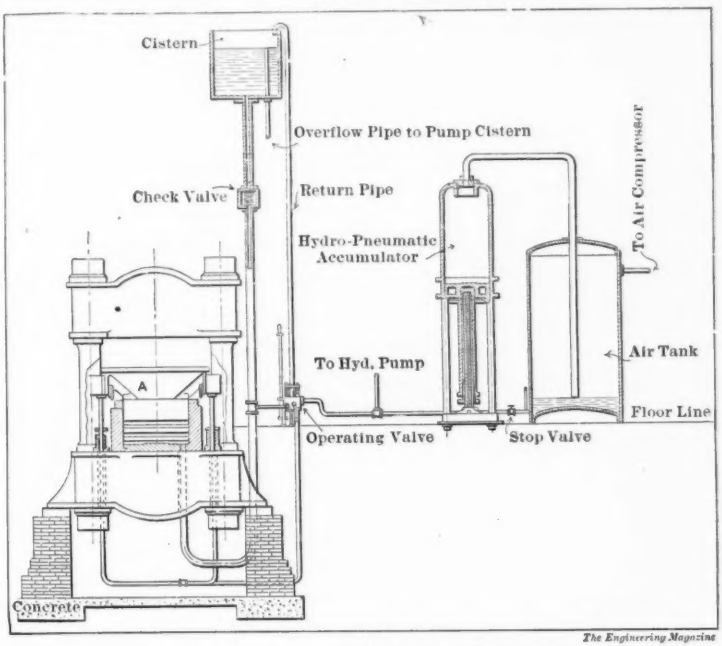
admitting the above steam pressure directly into the cylinder of an accumulator, a final pressure would be exerted at the delivery of the ram cylinder in proportion to the difference in areas:—thus, a 16-inch steam piston with 3-inch ram would exert a pressure of 2,800 pounds per square inch in the cylinder of the hydraulic machine. To keep the steam at constant pressure in the cylinder a reducing valve should be used, and set at some pressure less than that of the steam boiler.

A hydro-pneumatic-press operating system is shown in connection with a 2,500 ton press, the ram being 36-inches diameter by 11-inches-maximum stroke, the average working stroke being about 4 inches under the low pressure and about ½ inch under the final pressure. All the working parts are shown except the pump. The working of the press is as follows:—

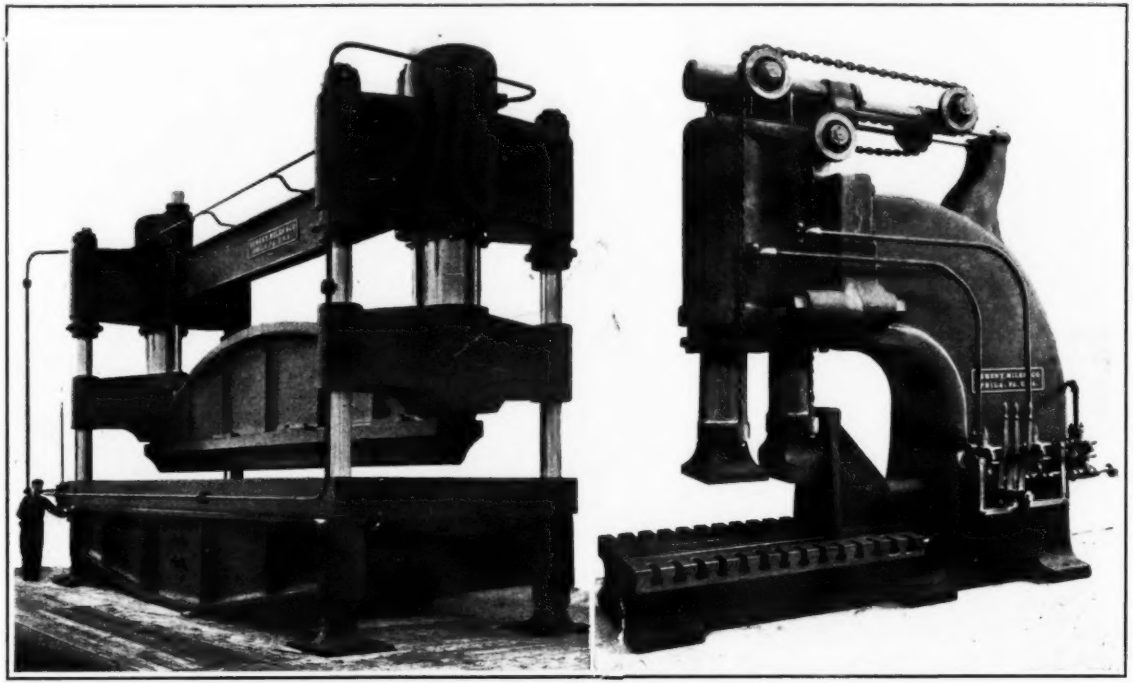
It having been determined what pressure the work requires, the air pressure is pumped up in the air tank to such a point that the product of the ratio of area of press ram and high-pressure end of the intensifier by the low-pressure end and the air pressure shall equal the desired pressure. Then the raising of the low-pressure valve piston permits water from the gravity tank to flow direct to the press, the reversing cylinder being at the same time relieved of strain, raising

the press platen up to the work proper. The power pump having forced the intensifier piston to the top of its stroke, the raising of the hydraulic pump-valve spindle permits the air from the air tank to force the intensifier piston down and exert at once the pressure desired, a check valve in the gravity-tank pipe preventing the water flowing to that point. There are small cylinders on the press for reversing or drawing the platen down and raising the water to the gravity tank. When the main valve is reversed, the liquid in the press cylinder goes upward to the gravity tank, and from there the overflow goes to the pump reservoir, when it is ready to be pumped to the hydraulic-pump side of the intensifier.

The hydraulic pump runs continuously except when cut out by the intensifier reaching the top of its stroke. The air pump is to be run only a short time each day to fill up the loss from absorption, which is very little as the system is a closed one. Small valves are provided to cut off the air tank or to permit water to be forced into it, if necessary. To have this system work properly, it is easy to see

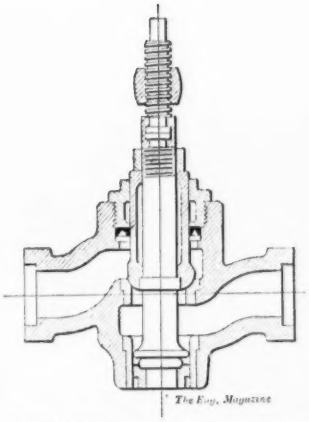


HYDRO-PNEUMATIC PRESS-OPERATING SYSTEM.
The Watson-Stillman Co., New York.



SOME TYPICAL AMERICAN HYDRAULIC MACHINES.

That on the left is a garboard-bending machine, made 24 feet 8 inches by 8 feet between posts, with a maximum effective pressure of 450 tons. That on the right is a universal hydraulic flanging press, the two vertical pistons each having a stroke of 30 inches with a pressure of 75 tons, and the horizontal one a stroke of 24 inches with a pressure of 20 tons. Both are by the Niles-Bement-Pond Co., Bement shops, Phila., Pa.



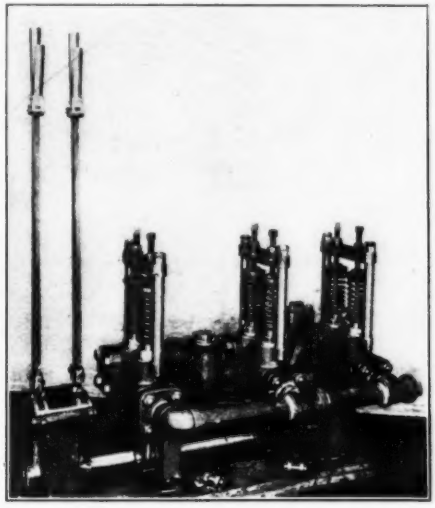
WATSON-STILLMAN BALANCED-SPINDLE STOP VALVE.

that it must be all designed to work together, and two presses calling for different pressures cannot be used at once.

Water being practically incompressible, a sudden stoppage of flow, as in the case of a rapidly falling accumulator, means a very severe impact in the pipes, and breakages are liable to occur. For this reason relief valves are provided. A curious thing about a relief valve is that it is not a valve at all, but simply a piston fitting into a bored cylinder and having a heavy spring above it which is sufficiently in tension to prevent compression under all working conditions, but which yields under sudden impact, thus preventing breakage of pipes, fittings, or pump valve chambers.

Balanced-spindle stopvalves are a necessary detail in any hydraulic system in which there is more than one machine connecting with a pressure-pipe-line. The valve illustrated has been made in sizes up to 6 inches in diameter operating under 2,500-pounds pressure per square inch; the valve is perfectly balanced except for the small area in contact at the seats.

The universal hydraulic flanging press opposite is designed to do a variety of flanging work with comparatively few dies. The two vertical pistons each exert 75-tons pressure and have 3-inches stroke; the horizontal piston exerts a pressure of 20 tons and has 24-inches stroke. The maximum distance between the vertical pistons



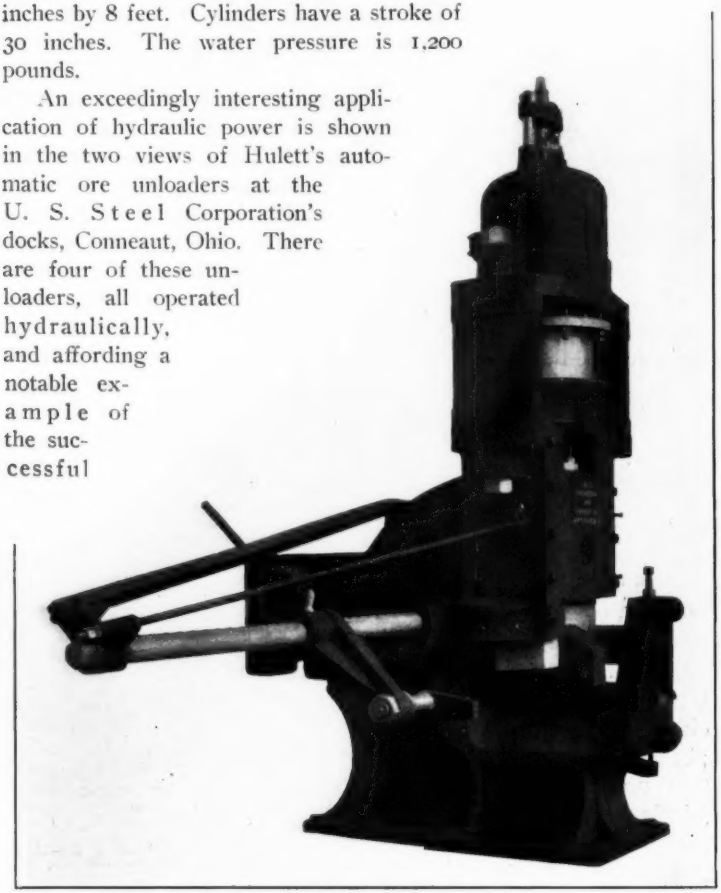
A SET OF 2-INCH BALANCED-SPINDLE HYDRAULIC-PRESS AND INTENSIFIER GOVERNING VALVES.

The Watson-Stillman Co., New York.

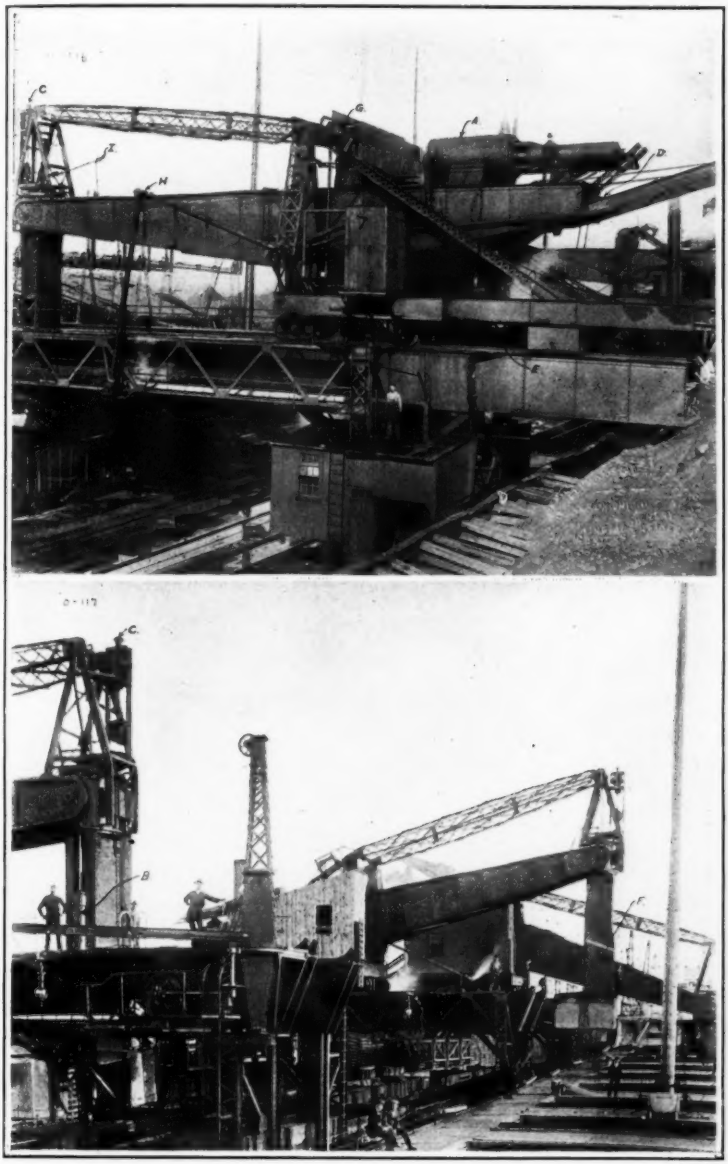
and the table is 42 inches. All the pistons are returned by hydraulic drawback cylinders. The water pressure is 1,500 pounds per square inch.

A garboard bending machine designed for bending keel plates, garboard strakes, sponsons, and miscellaneous irregular plate work is shown on page 832. The maximum effective pressure is 450 tons. Both ends of the bending beam may be operated together or either end independently. The usual length of the beam is 26 feet 5 inches; the usual clear distance between the posts is 24 feet 8 inches by 8 feet. Cylinders have a stroke of 30 inches. The water pressure is 1,200 pounds.

An exceedingly interesting application of hydraulic power is shown in the two views of Hulett's automatic ore unloaders at the U. S. Steel Corporation's docks, Conneaut, Ohio. There are four of these unloaders, all operated hydraulically, and affording a notable example of the successful

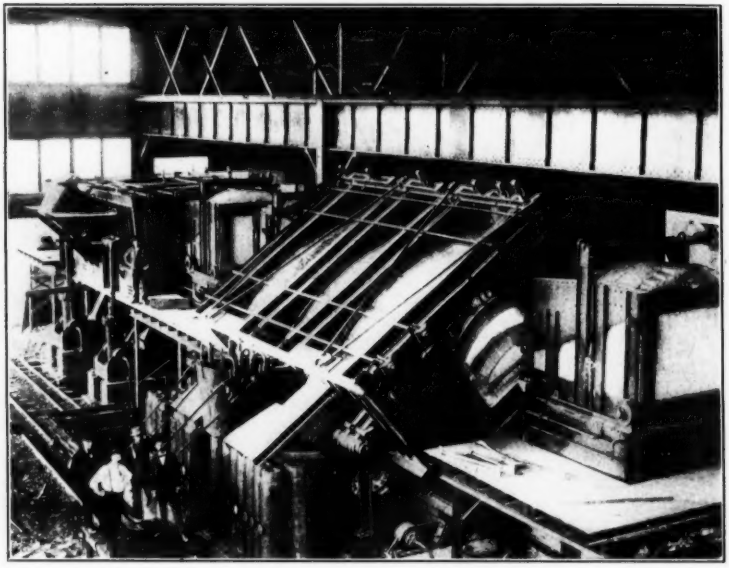


HYDRAULIC BILLET SHEAR, WATER PRESSURE 750 POUNDS PER SQUARE INCH.
United Engineering & Foundry Co., Pittsburg, Pa.



TWO VIEWS OF THE HULETT ORE UNLOADER AT WORK AT THE CONNEAUT DOCKS, OHIO.

Built by the Wellman-Seaver-Morgan Co., Cleveland, Ohio.



ROLLING OPEN-HEARTH STEEL FURNACES, HAMILTON STEEL & IRON CO.
TILTED BY HYDRAULIC POWER.

Built by the Wellman-Seaver-Morgan Co., Cleveland, Ohio.

application of hydraulic power to extremely severe and heavy work.

The walking beam carries a dependent leg, with an automatic grab bucket which holds 10 gross tons of ore, scooping up the ore from the hold of the vessel, and carrying it back over the dock where it is discharged into railroad cars.

The use of hydraulic power for tilting a steel furnace is a somewhat novel application in hydraulic engineering. The cut above represents two Wellman patent rolling open-hearth furnaces at the Hamilton Steel and Iron Company, Hamilton, Ont., in which one furnace is shown tilted to the pouring position. The rolling movement of each furnace is accomplished by two hydraulic cylinders mounted on trunnions at their lower ends, and having the upper ends of their piston rods attached to the pouring side; to tilt the furnace, water is admitted to the top end of the cylinder.

Ordnance engineers have applied hydraulic mechanism to gun carriages with great saving in labor, together with greater rapidity of discharge. As compared with electrical equipment, the hydraulic

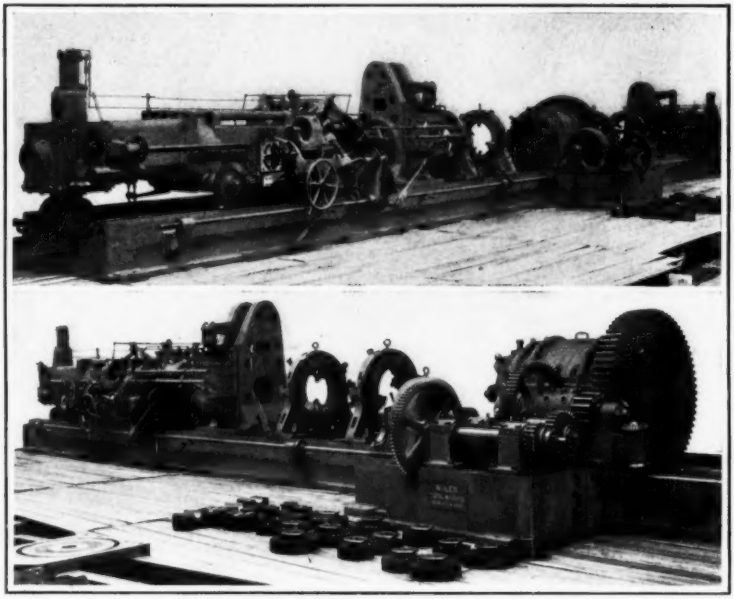
mechanism is preferred—amongst other reasons, because with the severe shocks which are experienced in firing heavy guns there is less likelihood of the massive built hydraulic mechanism being injured than would be the case with electric gear; and, in the event of slight damage resulting, its existence and location are at once discovered, owing to water leakage. The water pressure commonly used for this purpose is 1,000 pounds per square inch.

Engine lathes for boring and cutting off steel ingots are now adapted with hydraulic feed to the boring bench. The boring bar is held securely in and carried by a hollow piston which forms a part of

HYDRAULICALLY OPERATED COAL-WAGON TIPPING PLATFORM.

Hydraulic pistons, moving horizontally the trunnions carried on the side brackets, cause the platform to roll on rockers below. Sir Wm. Arrol & Co., Ltd., Glasgow.

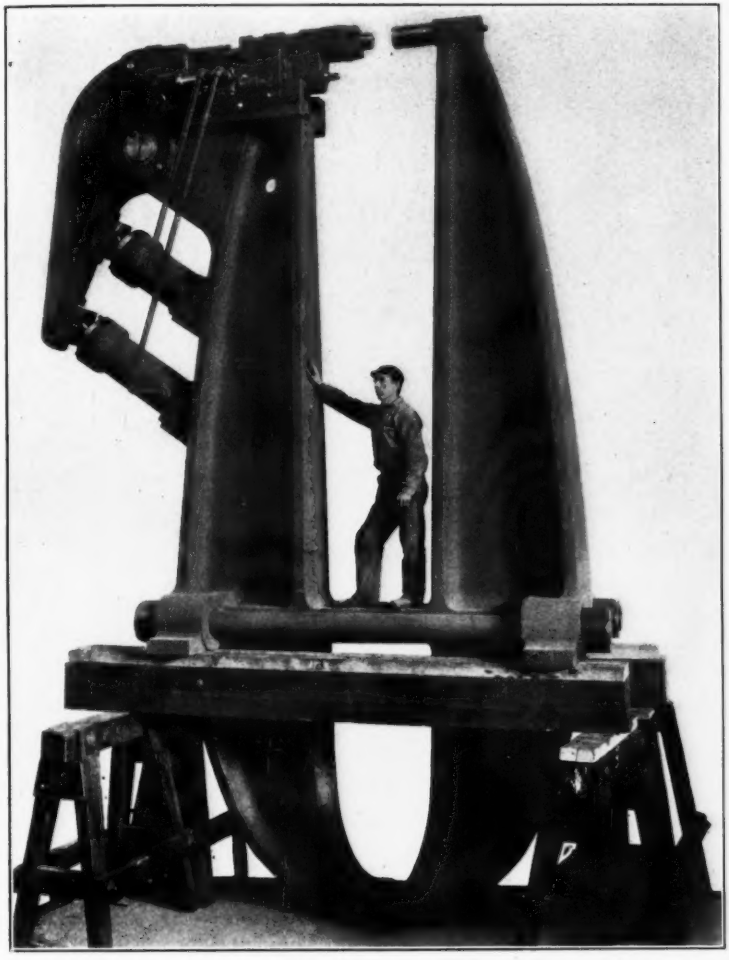
the boring feed device; end pressure is given the boring bar through an accumulator acting on the piston in a hydraulic cylinder which is, of course, in excess of the requirements of the cutting tool. This end pressure is resisted by a revolving nut engaging with an elongation of the piston, the nut being placed between end thrust bearings. The amount of feed is determined by the rotary motion given to the nut. This device forms an escapement system entirely free from any possibility of the boring tool jumping forward and hanging in the ingot.



HYDRAULIC BORING LATHE, FOR GUN FORGINGS, MARINE SHAFTS, AND LARGE INGOTS GENERALLY.

Takes in a shaft 60 feet long, 30 inches diameter, and bores a hole 12 inches diameter the full length, or 14 inches for short lengths. Two boring bars, fed by hydraulic pressure, are used, one from each end. Pressure 720 lb. per square inch, giving a total of 200,000 lb. against the piston; driven by a 100-horse-power motor; change gears and friction discs give a wide range of speeds; handles for operating the various valves are placed both at front and rear. The Niles-Bement-Pond Co.

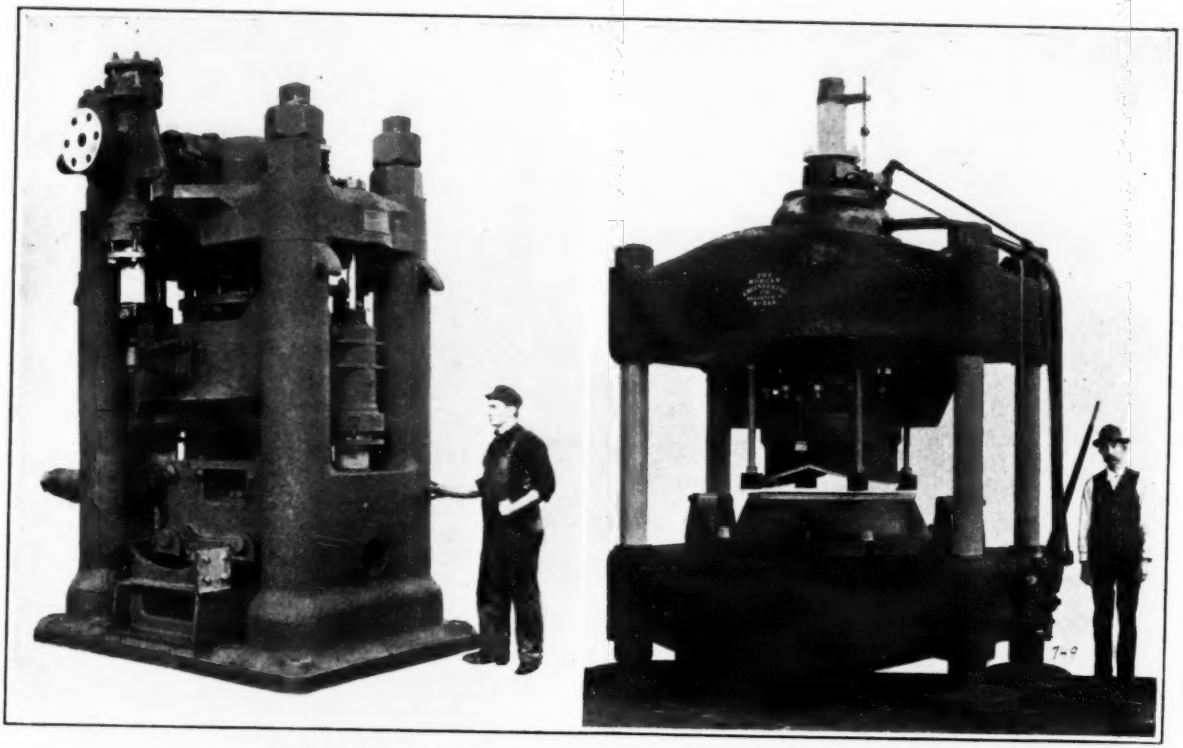
Hydraulic punching and shearing machines are now in very general use in ship yards, large boiler shops, structural steel works, etc. The one illustrated on the facing page has 12-feet depth of throat, and is arranged to give three separate pressures on the dies—50, 100, or 150 tons, with water pressure at 1,500 pounds. This is secured by operating the ram, through the lever, by either one or by both of the cylinders on the back of the frame.



A LARGE HYDRAULIC RIVETING MACHINE. THE THROAT IS 12 FEET DEEP.

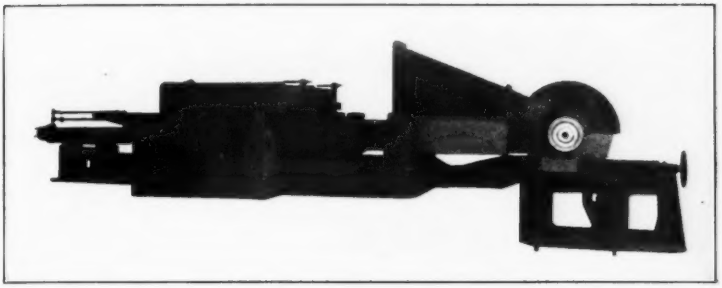
Gives three separate pressures upon the dies—50, 100, and 150 tons with 1,500 lb. water pressure. The ram is operated by one or other or both of the cylinders on the back of the frame. Wm. Sellers & Co., Inc., Phila., Pa.

As compared with a power-driven machine in which there is a large and heavy flywheel and a train of gears, if a hydraulic machine can do the work, it is, in general, to be preferred. For example:—if a piece of material be placed between a punch and die, or between the



HEAVY SHEARS AND PUNCHES OPERATED BY HYDRAULIC PRESSURE.

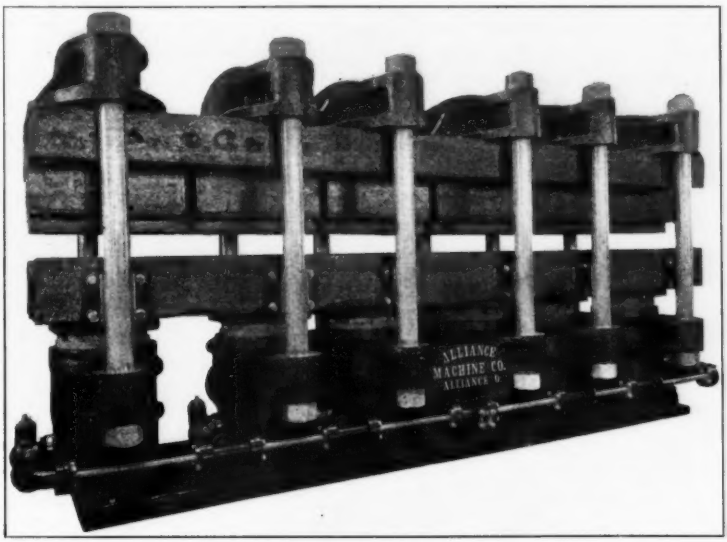
The machine on the left is a hydraulic beam shear, built by the United Engineering & Foundry Co., Pittsburg, Pa., working at a water pressure of 1,500 lb. per square inch. That on the right is a hydraulic manhole punch; it is designed and built by the Morgan Engineering Co., Alliance, Ohio.



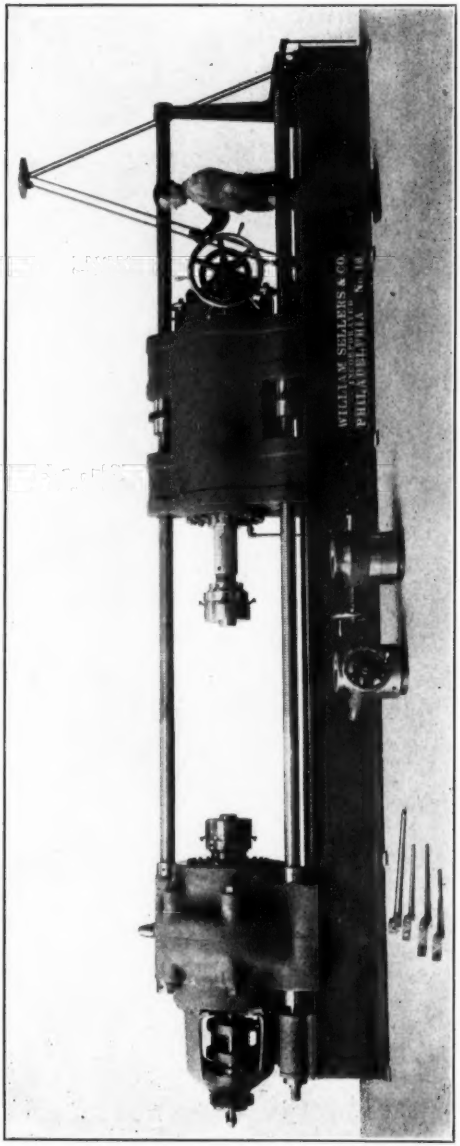
HIGH-SPEED COLD SAW WITH HYDRAULIC FEED AND OIL CYLINDER FOR CHECK.
United Engineering & Foundry Co., Pittsburg, Pa.

blades of a shear requiring greater capacity than the geared machine was designed for, destructive strains would be set up in the machine which would probably result in breakage; whereas in the case of a hydraulic machine the plunger would simply come to a standstill and remain thus without doing any harm whatever.

Another advantage in the application of hydraulic power to a punch and shear is that power is consumed only when in use, the ma-



SIX-CYLINDER HYDRAULIC PRESS FOR VERY LONG SHAPES.
Gives three pressures, the cylinders being coupled in pairs so that any pair may be cut out.
Alliance Machine Co., Alliance, Ohio.



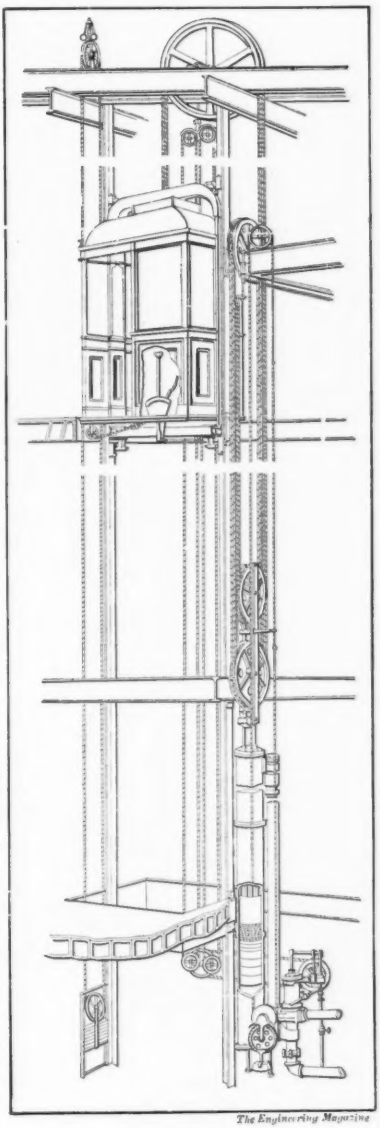
chine has few wearing parts, the load is always definite in amount and cannot be increased, and, when properly designed, destructive strains are never set up while in use, because the pressure is a fixed quantity. The element of time is one not to be overlooked in heavy punching and shearing; the hydraulic permits, as no other system does, the separation of the particles of metal in a straight line between the punch and die or between the shear blades.

Hydraulic elevators are so largely used in office buildings, apartment houses, hotels, etc., that their adoption as a means of communication between different levels is greater than that of any other system. The construction mostly in use consists of a cylinder and piston with suitable valves for the admission of water on either side of the piston, and providing for the discharge of

water from the cylinder end opposite to that of the entering water. One or more piston rods attached to the piston pass through stuffing boxes in the cylinder and are secured to a crosshead, which operates the car by means of wire ropes. These lifting ropes pass over sheaves by which any degree of multiplication of speed can be secured, ranging from four to one up to twelve to one; that is, the car travels in the latter case twelve times as fast as the piston. The cylinders may be vertical or horizontal as will best suit the local conditions.

The speed of the elevator car in buildings of five or six stories is generally about 150 feet per minute, but in high office buildings the speed is about 400 feet per minute. The control of the elevator is always from the car, and this requires in the case of high speeds a device for operating the valves which shall operate quickly, but without producing a jar or other disagreeable sensation in the car.

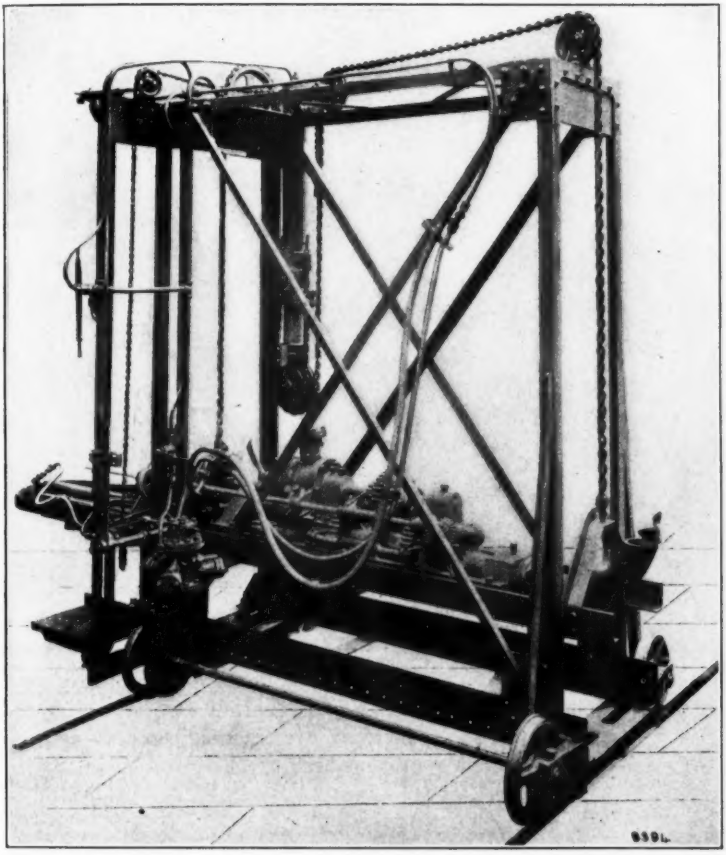
Hydraulic cranes were at one time in a fair way of general application and adoption, but the present trend is towards the electric system. The principal defect in hydraulic cranes lies in the use of chains passing over numerous sheaves, giving



SCHEMATIC OUTLINE OF HYDRAULIC ELEVATOR.

TWO HYDRAULIC TRANSPORTER CRANES ERECTED FOR THE STEAMSHIP OWNERS' COAL ASSOCIATION, LTD., AT THEIR NEW CONCRETE-STEEL PIER, PURFLEET, ESSEX.

Each is capable of delivering more than 70 tons of coal per hour from steamer to barge. Designed and erected by Sir W. G. Armstrong, Whitworth & Co., Ltd.

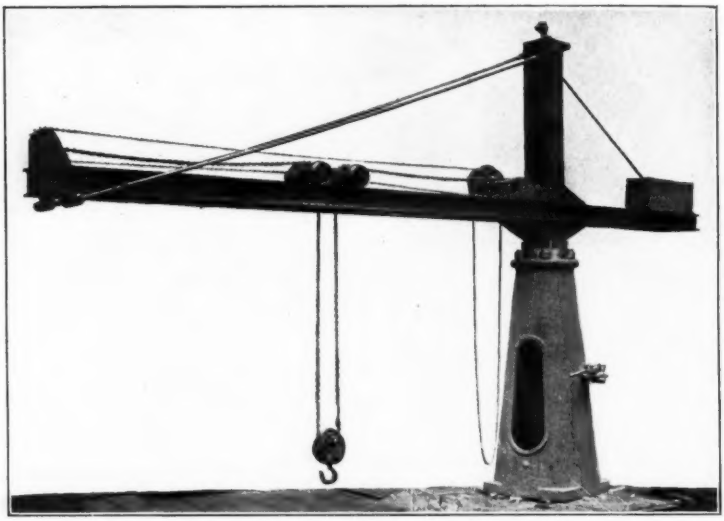


HYDRAULIC DEVICE FOR CLEANING THE ASCENSION TUBES OF GAS RETORTS.

The cleaning tool is brought to the mouth of the retort, pushed up the ascension pipe by a hydraulic cylinder, and rotated by a hydraulic motor carried on the rising and falling beam; all controlled by one man on the platform on the left. Sir Wm. Arrol & Co., Ltd., Glasgow.

rise to a great amount of friction, and in the fact that as much energy is consumed in lifting a light lead as if working up to the maximum limit. In exposed situations hydraulic cranes are liable to freeze fast during the winter months, unless carefully protected from a cold atmosphere, which is not always convenient.

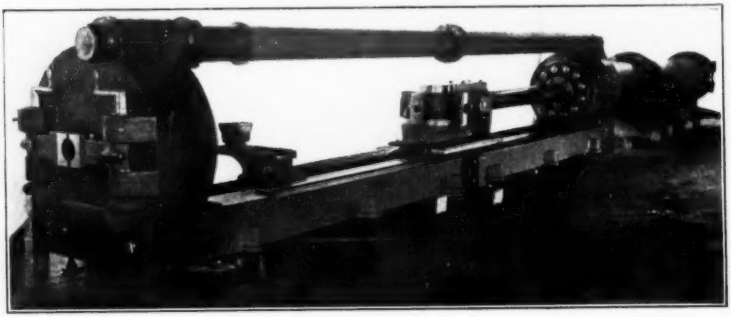
On the other hand, it has been pointed out previously in these pages, especially in the articles by Mr. E. B. Ellington, in June,



SELF-CONTAINED HYDRAULIC YARD CRANE.

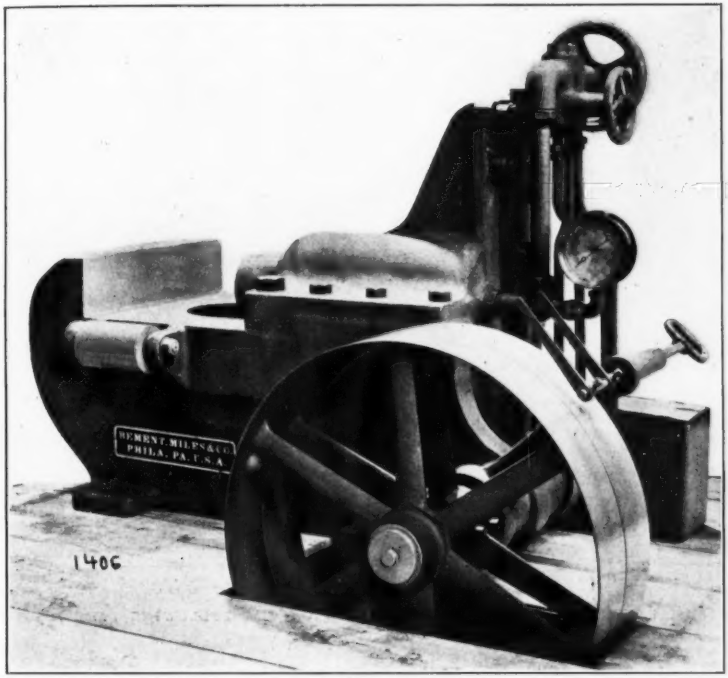
Musgrove Bros., Leeds, England

1899, and by Mr. George H. Baxter, in March, 1904, that hydraulic power in this connection stands quite alone and apart from all other systems of power application in virtue of its pressure being applicable directly to the lifting appliance, without the intervention of any gearing or other mechanism. On this account its advocates plead its claims to absolute safety, simplicity of construction, certainty of control, and freedom from reliance on brakes. They also point to its



HYDRAULIC PUSH BENCH, FOR DRAWING LARGE COPPER OR BRASS TUBES OVER AN ARBOR OR PUNCH.

perated at 2,000-lb. pressure from a pump or 1,000-lb. from an accumulator system. Floor space 47 feet 9 inches by 4 feet 2 inches; cylinder 18 feet by 18 inches. Waterbury Farrel Foundry & Machine Co., Waterbury, Conn.

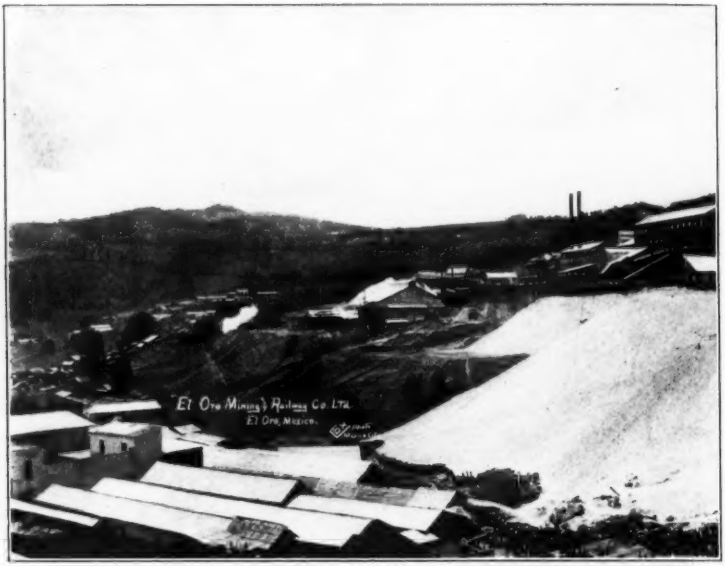


A HYDRAULIC RAIL-BENDING MACHINE.

Capable of bending rails up to 100 lb. per yard in weight; arranged for either belt or electric-motor drive. The Niles-Bement-Pond Co., N. Y.

high efficiency, as high as 95 per cent, when used directly in lifts at full load. It may be freely admitted that for many purposes hydraulic power will remain more suitable than any other form, and at present there are many impressive examples of its use in large crane hoists, especially about the larger shipping ports and docks of Great Britain. One of the latest installations is represented in the illustration on page 844.

The principal advantages of hydraulic transmission of power may be briefly stated to be that, in the case of intermittent work, the accumulator is so nearly perfect in its action that it will always give out energy in proportion to the quantity of water used. It is equally applicable in systems requiring either much or little pressure, large or small volume.



Town, 10,000 pop. Chihuahua Cyanide Tanks and Tailings Carmen Mine No. 2 Mill 100 Stamps

PANORAMA OF EL ORO. CONTINUED ON THE FOLLOWING PAGES.

ELECTRIC MACHINERY FOR THE OPERATION OF MEXICAN MINES.

By Charles V. Allen.

In a preceding article Mr. Allen outlined generally the part played by electric power in revivifying the mineral industry in Mexico. He follows now with a concrete description of one of the largest and most complete installations—that at El Oro.—THE EDITORS.

MEXICO is one of the richest countries in the world in the production of minerals—first in the production of silver, second in copper, and seventh in gold. It is estimated that since the royal mint was established in 1537, up to 1899, the output of silver in Mexico amounted to about $3,500,000,000 Mexican currency. There is more than $125,000,000 of capital invested in the mines and smelters of the country.

The enormous wealth of the Mexican mines is found more in the large quantity of ore than in its richness. In 1904-05 the production of gold, silver, copper and other metals amounted to $70,200,000. The amount of silver produced is vastly in excess of the gold, this

PANORAMA OF EL ORO. THE TAILINGS PILE CONTAINS 400,000 TONS.

being accounted for by the fact that few gold veins exist, the gold being combined with the silver in most cases. Little attention is paid to placer mining in gold, it having proved impracticable on a large scale. The early mining was naturally surface work, resulting from the finding of outcroppings of very rich ores, and camps such as Pachuca, Guanajuato, Zacatecas, etc., now show these old surface workings. The early method of mining was to dig into the side of a hill, or downward, until water was struck, when the working would have to be abandoned for lack of contrivance to remove the water. A crude Mexican hand-operated pump, used somewhat in later days, consisted of a raw-hide rope passed over a large wooden wheel, to which was attached an endless chain of buckets, dipping into the water below and emptying into a trough over the side above as the wheel revolved. A number of short sticks were knotted into the rope engaging the wooden crossarms on the circumference of the wheel to prevent slipping, thus providing a crude sort of rack and pinion.

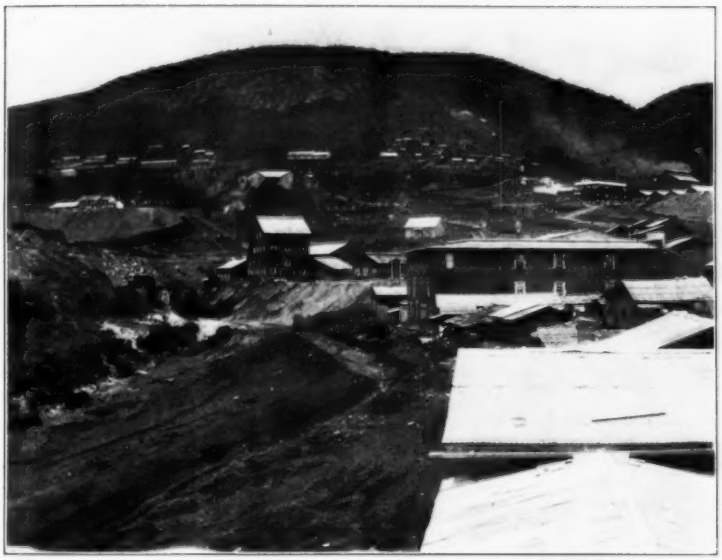
One of the first methods of crushing ore was by means of *arrastras*, consisting of a wooden framework slowly revolved horizontally,

EL ORO PANORAMA CONTINUED. THE SUB-STATION RECEIVES CURRENT AT 60,000 VOLTS FROM NECAXA, 171 MILES.

to the arms of which were tied large grinding stones. These were dragged in a circle over ore which had been previously broken by hand or in a stamp. They were operated by water power direct, or by mules, in a very crude manner.

The original *patio* process of silver extraction employed barefooted boys; in the later modification a number of mules were driven abreast about a circular paved or cemented yard, or *patio,* upon the floor of which the crushed ore was spread. Salt and blue vitriol, together with mercury were then added, the mercury being applied after the copper, salt, and the whole trodden for several weeks. This process is still in use in many places in Mexico, though mechanical means are being more employed for mixing, thereby saving no time but considerable expense of treatment and mercury.

The mines of El Oro are located in a town of the same name, in the State of Mexico, on a branch railroad six miles from Tultenango, a station on the National Railroad. It is about 100 miles northwest of Mexico City. The altitude above sea level is 10,000 feet, and the population today is about 15,000, of whom about 500 are English-speaking.



THE END OF THE EL ORO PANORAMA, SHOWING THE PRINCIPAL MINES.

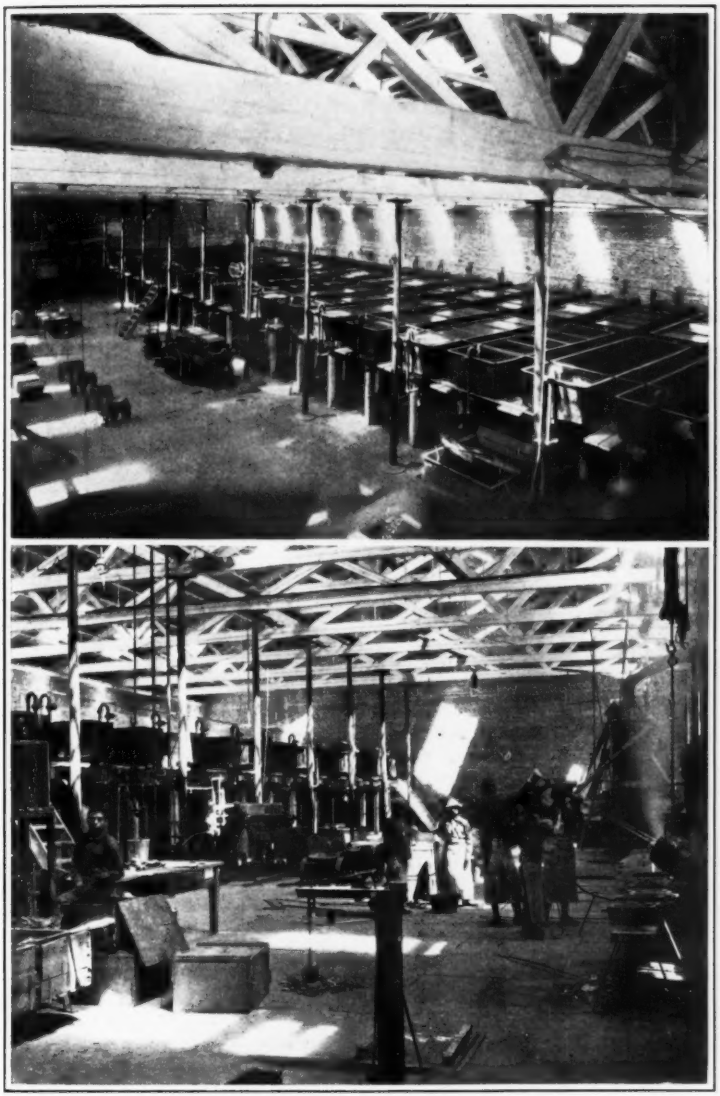
The entire district of El Oro is what is known as a "rich man's camp," on account of the depth of the apex of the vein below the surface and the expense entailed in sinking, timbering, pumping, hoisting, etc. A volcanic capping covers the slate, usually to a depth of 150 to 500 feet. The veins were formed in the slate previous to the volcanic overflow of andesite, or in the breccia, so that they have no outcrop to the surface. The dip of the veins is toward the west, from 60 to 70 degrees with the horizontal. The matrix is a pure silica containing the gold and silver in a finely divided state, invisible to the naked eye. The gold runs from a few dollars to $150.00, and the silver from $8.00 up to $10.00 per ton, United States currency. It varies in richness throughout its length.

The San Rafael vein extends through the Carmen, El Oro, and Esperanza properties, measuring from 20 feet wide on the south to 150 feet wide on the north, all within the El Oro boundaries, which are 5,200 feet long. The wider end of the vein is next to Esperanza, and from the loose nature of the rock, much timbering was necessary. There is cedar timbering known to be over 60 years old in good condition today in some of the shafts.

These mines were first worked by the Indians and Spaniards a hundred years ago, in an extremely crude manner, the ore being treated by amalgamation in *arrastras* or by the *patio* process, principally in the *hacienda* below the town. "Chicken" ladders, made of trees with notches cut for steps, were used in the shafts. These were in use until comparatively recently, and may still be found in some mines in the vicinity. The stories of the enormous weights the natives were able to carry up these ladders are hardly credible. The war of Independence for a time put a stop to the mining at El Oro, and it was not renewed until about 1821. English capital was being attracted to Mexico about this time. The United Mexican Co., with a capital of $6,000,000, took up the work. On account of the remoteness of El Oro and the unsettled condition of the country, frequent robberies and loss of life compelled this company to withdraw in 1857. They sold out the same year to "La Compañía Restauradora," who sank many new shafts, the principal one worked being the Providencia, which was sunk to some 700 feet. At this shaft the United Mexican Co. had installed a cylindrical Cornish pump and hoisting engine in 1828. The former was afterward moved to another mine in the Tlapujahua district, near by, from which it has but just been removed.

A number of Cornish miners were brought over to assist in the work in the mines, in 1847. As indicating the dangers of travel, it is stated that they were robbed four times en route to destination. Bandits frequently attacked the camp. The "Casa Blanca," which was a large building built on four sides of a central square or *patio,* and which at the present time serves as the offices and home of the manager, was at one time attacked by three hundred revolutionary Mexican soldiers in efforts to rob the company's treasury, but was safely held by the manager and sixteen Cornishmen. About 1849 an epidemic of diseases and plagues reduced the population one half.

In 1879 the El Oro mines passed into the hands of General Frisbie and J. B. Haggin, the new owners being organized as the American Mining Co. Ten stamps had been erected in 1873, and these were later increased to twenty-five stamps, with amalgamating pans, augmented by Chilian mills. In 1895 the first cyanide treatment was undertaken. Not enough water is taken from the mine to supply the needs of the milling and cyaniding, so that some has to be purchased from another source. In 1898 a 100-stamp mill was erected to treat 200 tons of ore a day. Several new shafts were also sunk during this period. There was at this time said to be enough ore to run this new mill twenty-five years.



THE ZINC ROOM IN THE CYANIDE PLANT.

The upper view shows the precipitation tanks; the lower one illustrates the pouring or casting of bullion bars.

In 1899 a narrow-gauge railway was built from Tultenango, on the National Railroad, to El Oro, and extended to timber lands 25 miles beyond. A large quantity of this wood is used for timbering the mine, and until very recently as fuel for the boilers. The El Oro Mining & Railway Co., Ltd., purchased the property from Messrs. Frisbie and Haggin in 1900. The workings of the El Oro mine are now down to a depth of 1,200 feet in the Somera shaft.

In Mexico, unlike in the United States, the owners' surface property line extends in a vertical plane downward, and beyond this he may not go. Up to 1895 no one believed that the San Rafael vein, upon which the El Oro Company was working, extended beyond this company's boundaries. Mr. August Sahlberg, ignoring this belief regarding the vein ending in the El Oro property, began what is now the Esperanza Mine, northwest of the Oro, and it is today one of the largest gold-producing mines in the world. Seventeen years ago the El Oro was the only claim in the El Oro district proper, while in 1900 there were between twenty and thirty, with but about five producing bullion.

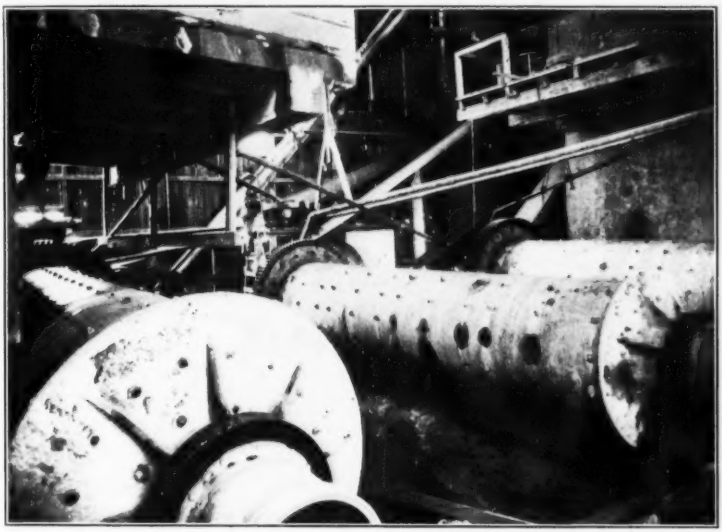
The gold is found in a state of extremely fine division, which renders either pan or plate amalgamation difficult; only about 15 to 20 per cent of the gold value is thus obtainable. The remainder is recovered by cyaniding; the cyanide process therefore has rendered possible the successful treatment of what, without it, would have been worthless. The cyanide attacks the infinitesimal parts of gold and dissolves them, after which the solution passes through zinc shavings on which the gold is precipitated.

Mr. P. L. Foster, general manager, reported in June, 1902, the average gross value of the whole quantity of ore treated for the eleven months preceding had been $17.32 per ton, in gold and silver, of which $13.52 was recovered; the working expenses, including mining, milling, development, taxes, amounted to $5.11 per ton. Mr. Foster resigned the management in 1902 to accept an important position with the Exploration Co., Ltd., of London, of which company the El Oro Mining & Railway Co., Ltd., is an allied interest. Mr. R. M. Raymond has succeeded him as general manager.

The wages now paid in the El Oro camp in Mexican currency per day are approximately as follows: boys 25 cents, *peones* 37½ cents to 50 cents, miners $1.00, timber men $1.50, mechanics $3.00 to $5.00. Wood costs about $8.00 per cord.

An additional 100-stamp mill, costing $1,005,000, was recently completed, being entirely paid for out of profits earned. It was started

late in 1905, operating 70 stamps in March, and the entire 100 stamps in May. In it were installed three large tube mills, belt-driven from the main shaft, for grinding the sands from the stamp. By means of these, two-thirds of the ore crushed is reduced to slimes and the remaining sands are reduced to 100- to 200-mesh fine, thereby getting a better extraction of gold and silver. $1,527,723.00 was produced in 1905 from mill and cyanide plants.



TUBE MILLS AT MILL NO. 2, BELT-DRIVEN FROM THE MAIN MILL SHAFT.

In consideration of the large amount of power used in the El Oro camp and vicinity, all being developed by steam, with wood costing from $3.50 to $4.50 per cord and American coal $11.00 per ton, United States currency, the Mexican Light & Power Co. decided to extend their transmission (already operating from Necaxa to Mexico City) 90 miles farther to El Oro, their circuit thus forming an obtuse angle, with Mexico City at the apex. They contracted with the three largest consumers, the El Oro Mining & Railway Co., the Esperanza Co., and Dos Estrellas, for approximately 10,000 horse power.

The source of electric power for the entire El Oro district is 171 miles distant, near Necaxa, in the State of Puebla, where the Mexican Light & Power Co. have their main generating station, one hundred miles northwest of Mexico City. Near Necaxa the Tenango River unites with the Necaxa River, giving a minimum flow in the dry

season of 1 cubic metre a second, with a maximum of some 90 cubic metres. The river drops 3,000 feet in about three miles, on its way to the Gulf of Mexico. The first plant, now being installed, will utilize two falls, making a total of 1,300 feet head or about 40,000 electric horse power. A second fall of 1,300 feet is available down stream, for the further development of 40,000 horse power more when needed. The water wheels used are capable of developing 8,200 horse power each, and there will be six 5,000-kilowatt, direct-connected, vertical-shaft, alternating-current generators, revolving-field type, 3-phase, 4,000-volts, 50-cycles, making 300 revolutions. This voltage is raised by transformers to 60,000 volts, and the energy transmitted about 96 miles to Mexico City, over four 3-phase circuits comprising twelve 168,000-circular-mils stranded copper cables, each of which corresponds to about No. 000 B. & S. wire.

THE DISTRIBUTING SUB-STATION AT EL ORO.

These cables are carried on two steel-tower lines, two circuits to a line. A similar single-tower line with two circuits transmits a part of the energy from Mexico City to El Oro, a distance of 75 miles. In El Oro at the sub-station, which is equipped with lightning arresters, transformers, and switchboard, the voltage is reduced to 3,000 volts before distributing to the various mining and milling customers, the

most distant of which is about six miles. There are seven 1800-kilowatt transformers installed in this sub-station.

The El Oro Mining & Railway Co., during the latter part of 1905, purchased of the Westinghouse Electric & Manufacturing Co., of Pittsburg, Pa., its entire electrical equipment of motors, generators, transformers, switchboards, etc., amounting to some 4,000 horse power of machines. This has been installed, and the mine, mill, and cyanide plant have been operating in part electrically since early in January, 1906. This, too, at a time when the expense of developing power from wood was increasing owing to the longer hauls and difficulty of lumbering. Inasmuch as the Esperanza Company is also entirely equipped electrically, no smoke is now to be seen issuing from the once very busy stacks in El Oro. The methods adopted by the El Oro Company, which is today undoubtedly the largest electrically operated mill in the world, in changing from steam to electric drive without the necessity of abandoning the original machines employed in the mine, mill, or cyanide plant, may be of interest.

It might be said here that the one tool in use which seemed to defy motor application was the steam trip-hammer in the blacksmith shop. This finally succumbed, however, and is operated by compressed air supplied from an electrically driven compressor.

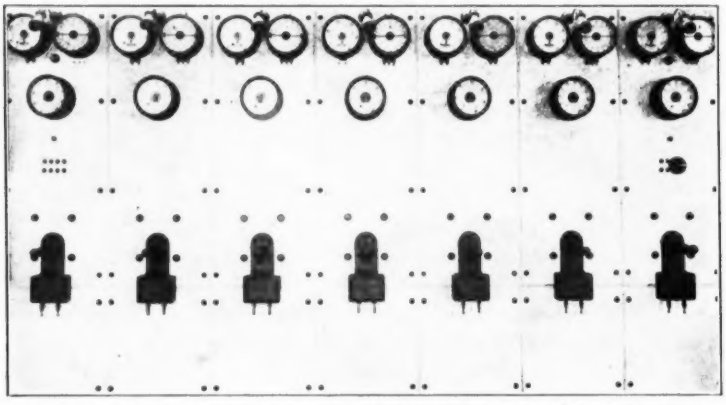
All the motors employed are 3-phase, 50-cycle (6,000 alternations) and as a rule are 400-volt, induction type for 200-horse-power and less, and 3,000-volt synchronous above 200 horse power.

A separate sub-station has been provided by the El Oro Co. to receive the current from the power company and distribute it to the various mills and mine shafts. Here the power is measured by the power company with integrating wattmeters and passed to the seven-panel Vermont-marble distributing switchboard, each panel of which contains the usual instruments and switches. Since the photograph was taken from which the cut on page 858 was made, integrating wattmeters have been added to the base panels so that each department can be charged up regularly with the power used.

Most of the ore is hoisted at the incline shaft and dumped automatically into hoppers feeding two large gyratory crushers, belt-driven by a 100-horse-power motor. Other individually motor-driven jaw crushers are also used to assist in handling the large amount of ore.

The duty capable of being performed by this hoist, unbalanced, is as follows: weight of ore, 6,000 pounds; weight of skip, 4,000 pounds; weight of rope, 2,000 pounds; hoisting speed, 900 feet per minute. This is to be operated from a direct-current motor, direct-

coupled to the pinion shaft of the hoist, the motor receiving its current from an alternating-current motor-generator set with a very heavy flywheel mounted on its shaft, all of which will be described* in connection with the Somera Shaft where the same novel economical system is employed. The only change necessary in the steam hoist to adapt it to electric drive was the replacing of the pinion shaft with a similar one slightly longer to receive a half coupling from the motor. This same method was employed with all the other hoists. In this way steam drive can be renewed at any time should it become necessary through lack of power. The changing of the shafts would require but about half an hour, or less time than necessary to steam up.

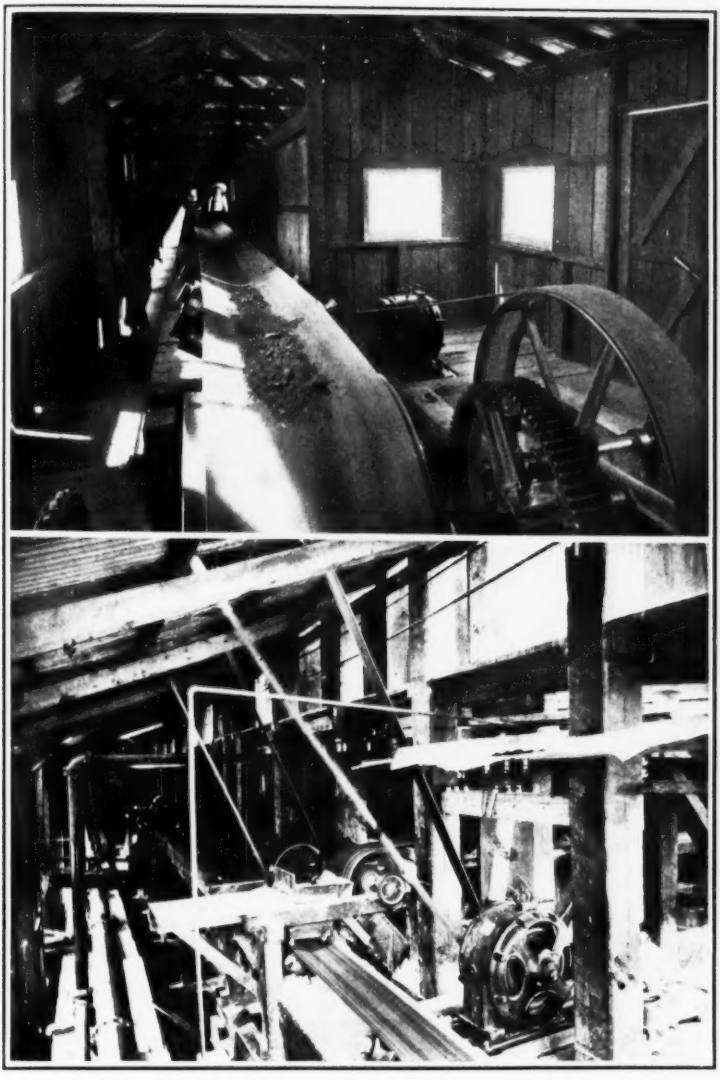


SEVEN-PANEL DISTRIBUTING SWITCHBOARD IN THE COMPANY'S SUB-STATION.

The ore from the crushers is run into cars and distributed in the ore bins above the stamps of Mill No. 1, which is very close, or run onto a belt conveyor and elevated slightly to the ore bins of Mill No. 2. In this it passes over three motor-driven belt conveyors and is distributed automatically at its destination. These conveyors require motors of 10 and 15 horse power capacity each. Ore is also supplied to Mill No. 2 from San Rafael shaft where it is electrically hoisted and crushed as at the incline. A belt conveyor connects this shaft and Mill No. 2. By this series of conveyors the ore can be automatically sent to whichever mill may be desired.

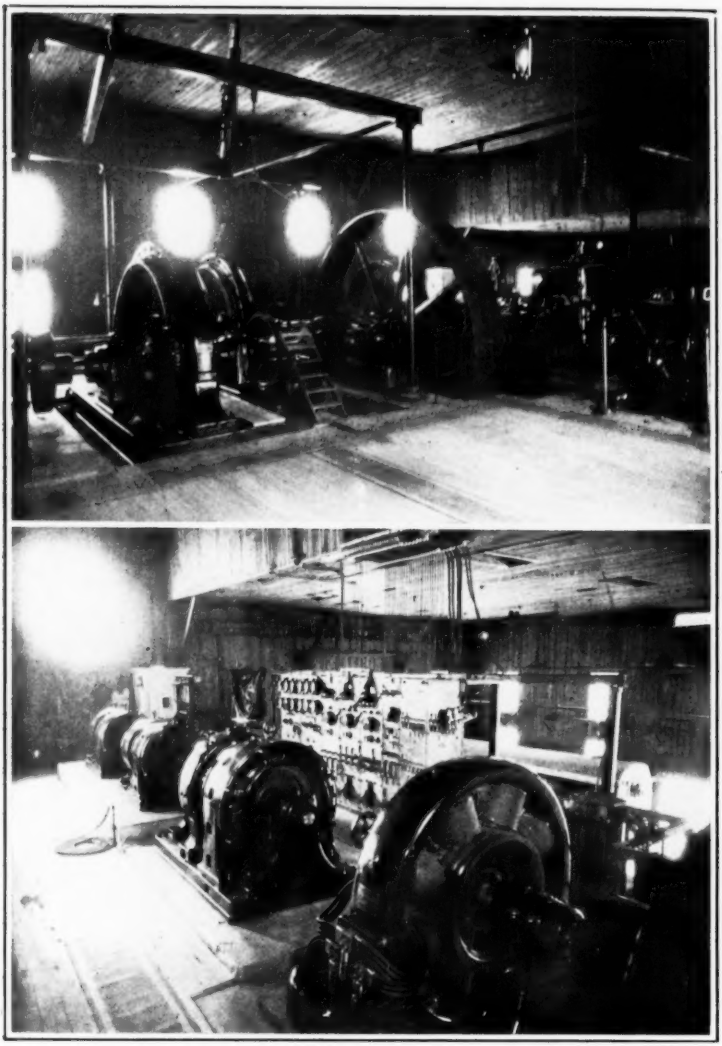
In Mill No. 1, the older mill, the main stamp shaft was formerly rope-driven from its engine; a 350-horse-power synchronous motor making 187 revolutions now rope-drives the same shaft. From this main shaft a belt drive transmits the power to the cam shafts of the batteries in groups of ten stamps. The cam shaft makes close to 50

*This will appear in the conclusion of Mr. Allen's article, in our October issue.—Ed.



SOME OF THE ELECTRICALLY DRIVEN CONVEYORS.

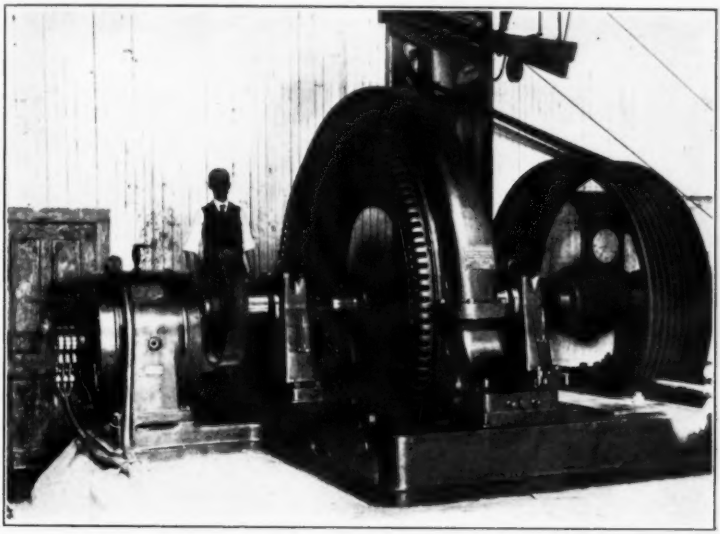
The upper view is of the ore belt conveyor from the crushers at the Incline shaft; the lower shows the sand belt conveyor.



TWO VIEWS OF THE NEW ENGINE ROOM, MILL NO. 2, EL ORO.

The upper one shows the 550-horse-power synchronous motor driving the main mill shaft, in the foreground, and 260-horse-power synchronous motor behind. The lower one shows the lighting set and exciter sets for synchronous motors.

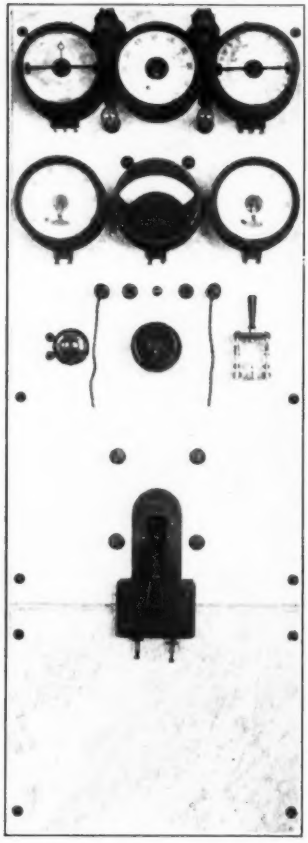
revolutions per minute to give about 100 drops to the stamps a minute, the cams raising the stamps being arranged in pairs, each being diametrically opposite in their position on the shaft. The stamps weigh 1,000 pounds each and are thus lifted 6 inches and dropped by the cams twice each revolution. The duty per stamp is 4.7 tons of ore every 24 hours.



SYNCHRONOUS MOTOR OF 350 HORSE POWER DRIVING THE MAIN MILL SHAFT, MILL NO. 1, EL ORO MINING AND RAILWAY CO.

This 350-horse-power motor, and indeed all the other synchronous motors, is started by means of a small variable-speed induction motor by single gear reduction, the pinion on the starting-motor shaft being on a feather key. Thus the motor can be cut out of service by a hand lever after the large motor is up to synchronism and connected electrically to its circuit. By this separate starting method no synchronizing power (power to keep in step) is lost in the motor, as would be the case were it built for self-starting.

Drum-type controllers and resistances are used to operate all the starting motors and blue Vermont-marble panels control the synchronous motors, these latter being supplied with synchroscopes, indicating wattmeters, power factor meters, ammeters for field and main-line currents, voltmeters, field rheostats, field discharge switches, and main-line automatic oil circuit breakers. Plug jacks are provided on



ONE OF THE SYNCHRONOUS-MOTOR PANELS.

the back of the switchboard for readily plugging in temporarily a portable indicating wattmeter when desired.

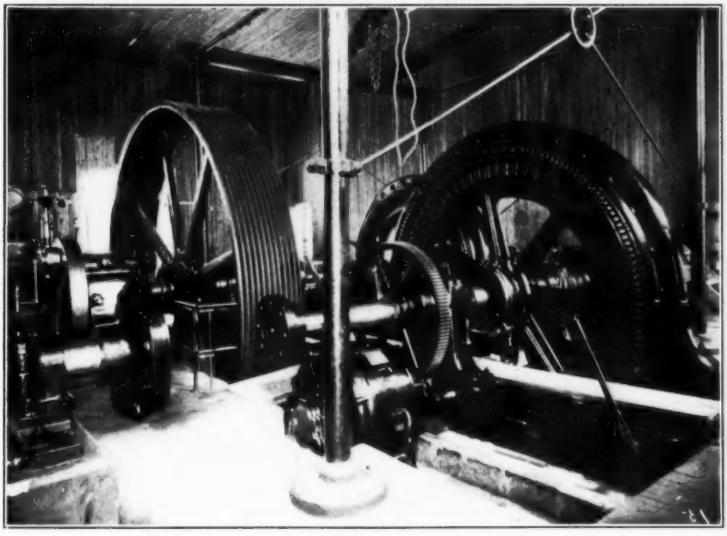
As the new mill had been originally ordered with provision for steam drive, before the possibility of electricity coming into the camp was known, it was thought best after contracting for the electric power to keep the engines as far as possible so that they could be placed in service quickly should there be any failure in the power service due to lightning or line disturbances. For this reason the 550-horse-power, 88-revolutions, two-bearing synchronous motor driving the entire 100 stamps and three tube mills, and the 260-horse-power, 88-revolutions, two-bearing synchronous motor driving the cyanide plant, were installed in a very ingenious manner. The motors were constructed with shafts extended on both ends to receive half couplings, the motors being installed between engines and shafts to be driven, with all shafts in each set in line. A flexible coupling of rubber cylinder type connects motor and driven shaft, and a special semi-flexible form of key-plate coupling connects motor and engine shaft. Normally, the bolts and the middle or key section of the latter couplings are left out when the motors are driving. In fifteen minutes or less these can be put in place, thus allowing the engines to drive the shafts, revolving the rotors of the motors at the same time. It has never yet been found necessary to resort to this expedient. On account of their very slow speed these motors are quite large for their capacity

The power service has been remarkably steady, considering the newness of the installation and the distance of El Oro from the source of power, and the power company are certainly sparing no expense to make the service absolutely continuous. The present manager of the power company, Mr. R. F. Hayward, who was formerly connected

with various companies in Salt Lake City and vicinity, will certainly bring this about if it is possible.

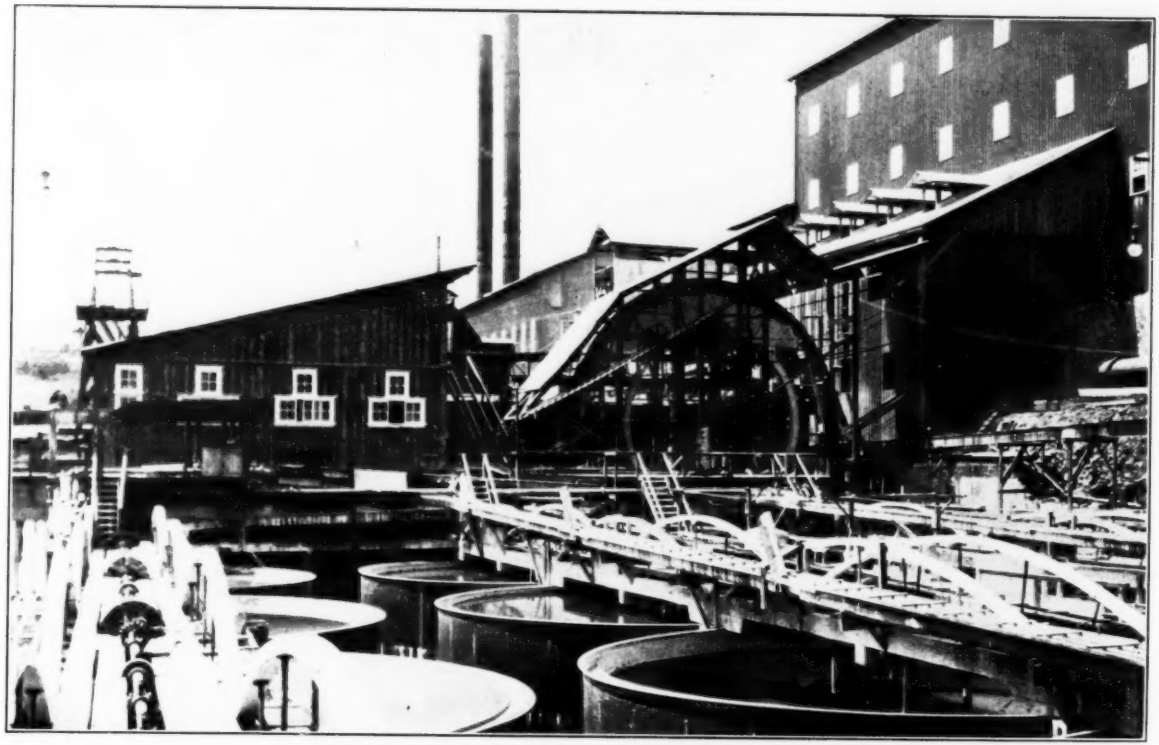
Ordinarily a stamp mill runs 24 hours a day, 365 days a year; nevertheless a brief shut-down may occur due to interruption in power or other cause while running. Any ten stamps in the mill, however, can be shut down at any time without interfering with the rest of the mill, by slacking up the idler pulley on the belt between main and cam shaft. In starting, the main motor is brought up to synchronism by its starting motor, which need be only of sufficient capacity to move the main-motor rotor and the main shaft, all the idlers having been slacked away. After full speed is obtained and the synchronous motor connected to the main circuit, the starting-motor pinion is slipped and the idlers tightened rapidly, so that the starting requires but a few moments. It was at first thought necessary to "hang up" the stamps, but the above method has been found much quicker and equally satisfactory.

A stamp mill cannot be rivaled for noise; but the contrast in the engine room, which is partitioned off from the mill proper, is very apparent, as these large, smooth-running motors make much less noise



PART OF THE NEW ENGINE ROOM, MILL NO. 2.

Showing in the foreground the 260-horse-power motor driving the cyanide plant, and behind it the 550-horse-power motor driving the entire stamp and tube-mill equipment.

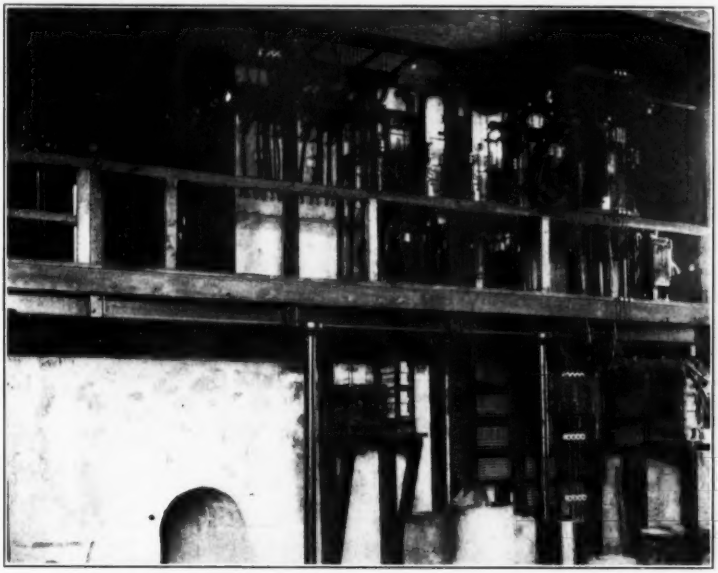


A SECTION OF THE CYANIDE PLANT.

The mechanical agitator shafts, one of which is shown on the left, and the tailings wheel in the background, are driven by individual motors.

than the former engines, not to mention the great saving in oil, repairs, and attendance.

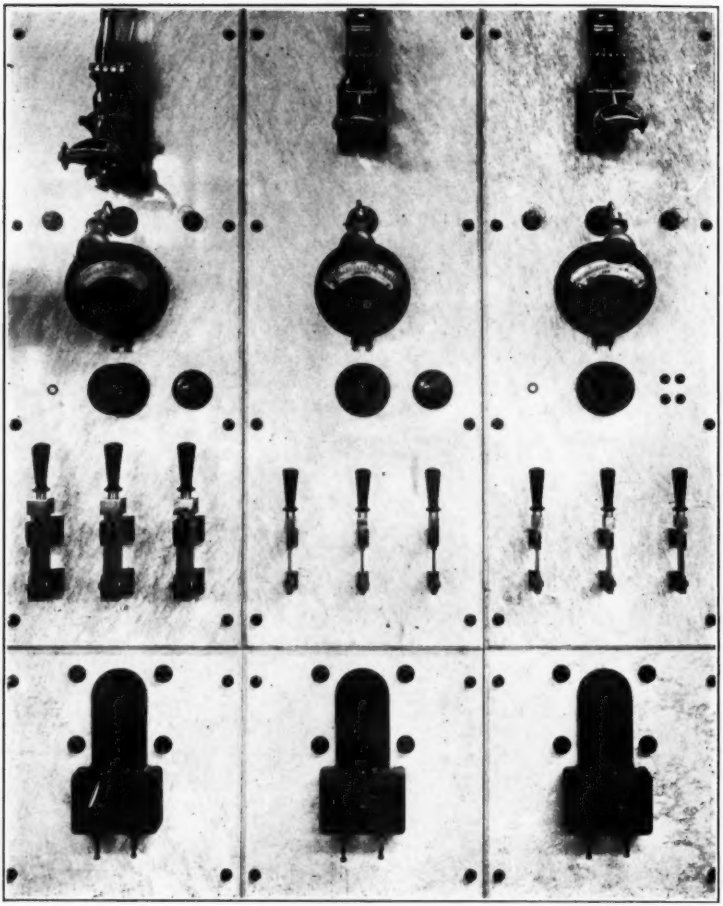
The auxiliary drives in the cyanide plant, which were operated from the shaft now driven by the 260-horse power motor, were originally made by means of long wire-rope drives, some through intermediate counter-shafts carrying the power a considerable distance. Later, individual-motor drives on the cyanide machinery have been installed in several places, avoiding long transmissions and cheapening operation. It is true, this obviates the possibility of driving the cyanide plant from the 260-horse-power engine. To offset this the



REAR VIEW OF SWITCHBOARD, NEW ENGINE ROOM OF MILL NO. 2.

260-horse-power synchronous motor which is connected to the engine will be driven as a generator, should it ever be necessary, feeding back through its own panel to the main distributing switchboard, whence the current can be distributed to the motors in whatever part of the mill or mine is without steam.

In the new engine room are also to be found a 150-kilowatt direct-current, 125-volt lighting generator coupled to an Ideal engine, a part of the original steam equipment. As new apparatus, there is a 150-kilowatt 580-revolution direct-current, compound-wound, 125-volt lighting motor-generator set, for lighting the entire plant and town of



PANELS FOR CONTROLLING MOTOR-GENERATOR LIGHTING AND EXCITER SETS, MILL NO. 2.

El Oro, driven by a 200-horse-power alternating-current motor, duplicating the above, and two 50-kilowatt 720-revolution direct-current, compound wound, 125- volt motor-generator sets driven by 75-horse-power alternating-current motors, each of which latter has a capacity of exciting the fields of all of the synchronous motors about the plant. These motor-generator sets are self-contained, each with a common base and shaft supported by two bearings. The switchboard for controlling all of the machines in this engine room is built of blue Ver-

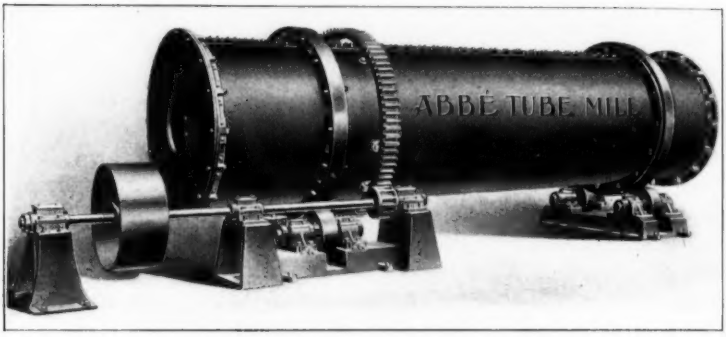
mont marble and comprises eight panels with all the necessary instruments.

The auto-starter employed to start the 200-horse-power motor and the other large induction motors about the plant, is of the multi-point, oil-immersed drum type, and being a recent and novel development by the Westinghouse Co., is worth a brief description. This type of starting device is used with constant-speed induction motors, 75-horse-power and over. It is bolted to the floor over a 16-inch hole cut in the same. The oil tank is bolted to the controller frame with two side bolts and is raised and lowered by means of a central threaded screw rod. The same handle that operates the controller, raises and lowers the oil tank by changing a nut at the top of the handle. The tank can be lowered below the floor two feet, which exposes all connections and contacts for inspection and repair. In operation the motion of the handle is always to the right, whether starting or passing from running to off. From six to nine different voltages are applied to the motor from off to full on position, depending on the horse-power capacity of the motor operated, thereby keeping down the peak which would otherwise result from the throw of an ordinary double-throw starting switch.

The ore from the stamps must be reduced to a sand fine enough to pass a 25 to 35 mesh screen, after which it passes over amalgamating plates which recover 15 to 20 per cent of the gold and 1 to 5 per cent of the silver. The amalgam from the plates when retorted into bullion contains about equal parts by weight of silver and gold.

The pulp from the plates was formerly passed direct to the cyanide tanks for treatment, in which latter process only about 80 per cent of the gold was dissolved, the loss being due to the sand grain still containing some gold secreted which the cyanide solution could not attack. Classifiers between stamp plates and the tube mills now separate the slimes and finest sands from the coarser sands, which latter pass through the tube mills. The three large tube mills receive the classified sands from Mill No. 2 for regrinding, and two additional tube mills, each belt-driven by a 50-horse-power motor, are being installed to handle the sands of Mill No. 1. Of the three tube mills, the smaller one has given the most satisfaction and least trouble, for which reason smaller mills were adopted for the second installation. The capacity of the smaller mills is but very little less, the expense of running is much lower, they are light, compact, and need little repair.

In setting a tube mill, special care is necessary with the foundations on account of the constant hammering of the revolving pebbles and



A TUBE MILL OF THE EL ORO INSTALLATION.
Abbé Engineering Co., New York.

vibrations of the spur gears, which tend to crystallize and break the anchor bolts and drive the mill into the cement. Tube mills for regrinding have proven most successful in El Oro, and it has been found by tests that a tube-mill efficiency increases directly proportionally to the amount of pebbles contained therein up to a certain point. The "Danish" pebbles used cost $36.80 per ton at the mill, the average pebble consumption being five pounds to the ton of sand. The lining of these pebble mills, which is subject to comparatively rapid wear, is composed of cast-iron strips, cast to fit the inside curved surface; these are made in the El Oro Company's foundry, having been found to last as long as the ones formerly imported from Germany, and to cost but half as much. The consumption of lining is roughly 1.2 pounds per ton of sand. Some preliminary comparative tests of the cost of grinding and regrinding by tube mills showed, per ton of sand passed through the mills, $0.367 using steam, and $0.274 using electric power. The cost of grinding fine sand was found to be far greater than for coarse sand, on account of the greater wear of pebbles and liners in the former case.*

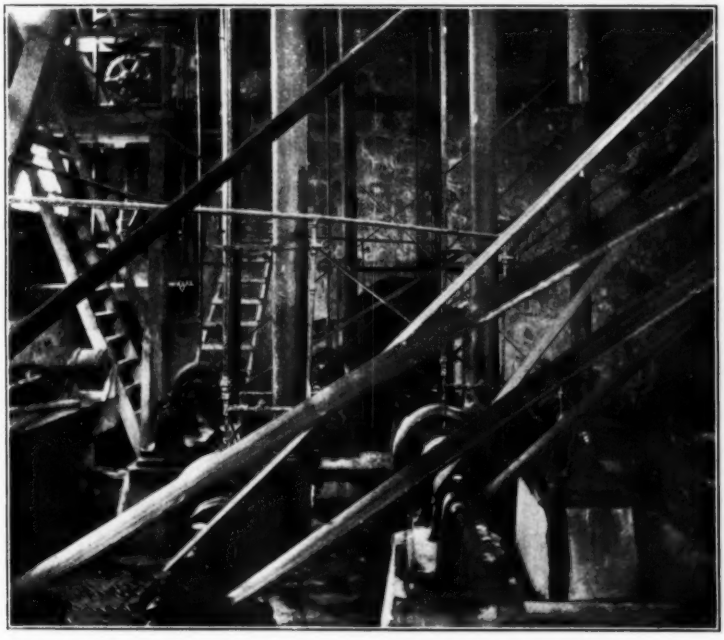
In the treatment of the slimes a number of small motors, 50-horse-power and under, are employed at a great saving over the former method by steam drive, due not only to the reduced cost of power per horse power, but to the ability to shut down motors on machines not requiring continuous operation in the process. In this work many machines are in operation only at intervals, some of the motors being idle

*A very thorough paper by Mr. G Caetarni and Mr. E. Burt, the latter having charge of the cyanide department for the El Oro Company, entitled "Fine Grinding of Ore by Tube Mills, and Cyaniding at El Oro", read before the American Institute of Mining Engineers, February, 1906, will prove interesting as bearing on this subject.

while the tanks are being refilled, emptied, or the solution changed from one to the other. The motors here are in all cases constant speed, except on the mechanical excavators and sand distributors, where they are variable-speed. The constant-speed motor applications are in part the tailings wheel, mechanical agitators, solution, slime, and circulating pumps, sand conveyors, stackers, etc.

There are two solution pumps for handling the cyanide solutions of different strengths, the cyanide being recovered and used over, and seven Butters pumps for the circulation of the slimes. The mechanical agitators are driven in groups of three to a motor. These agitators merely consist of wooden arms which stir the slime and cyanide solution together.

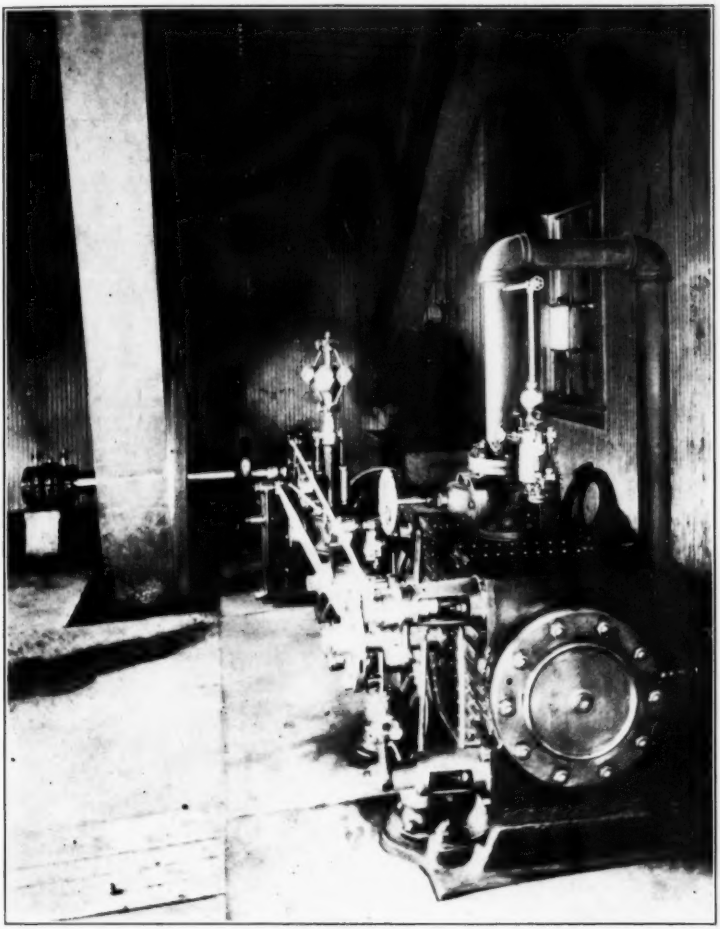
The mechanical excavators consist of a series of discs, similar to a disc plow, attached to radial arms supported above by a platform running on rails over the tanks. These rotate by means of a motor geared to the vertical shaft, plowing the sand toward a hole in the



SEVEN SLIME-CIRCULATING PUMPS IN THE CYANIDE PLANT, ELECTRICALLY DRIVEN.

The driving motor may be seen in the upper left corner.

MACHINE SHOP DRIVEN BY 40-HORSE-POWER MOTOR.



FRAMING-SHOP MOTOR, 40-HORSE-POWER; SHOWING THE ABANDONED ENGINE FORMERLY USED FOR THE DRIVE.

center of the tank where it falls onto a belt conveyor and is carried to other tanks, to be distributed therein and treated by cyanide again, or passes to the stacker where it is dumped on the tailings pile if its treatment is complete.

These excavators, as well as the sand distributors which are also constructed with platforms supporting the machinery over the tanks,

and mounted on rails, can be rolled over any tank desired, the current for the motors being taken from trolley wires at the side by sliding shoes.

The approximate cost of slime treatment by steam drive was $0.90 per ton as against $0.50 at present by use of electricity.

Several large electric centrifugal pumps for handling water are in use, requiring motors up to 130-horse-power capacity. One 130-horse-power motor drives a Gould's station mine pump in the incline shaft, handling 500 gallons of water per minute against a head of 800 feet.

The machine and framing shop each take a 40-horse-power motor, and other motors are located in the assay office, blacksmith shop, etc. A 150-horse-power synchronous motor by belting drives a 12-drill air compressor and a 200-horse-power 166-revolution direct-connected synchronous-motor air compressor is contemplated shortly. Two of these latter outfits are now in operation at the Dos Estrellas mines nearby.

At the North shaft, which is used principally for raising and lowering men and timber, there is installed a 120-horse-power variable-speed induction motor coupled direct to the pinion shaft of the hoist, the speed at full load being 194 revolutions. Although in addition to the motor the original mechancial brake is used, for further safety an ingenious device is used in employing the old steam cylinders of the hoist. In lowering a cage down the shaft the pistons are made to compress air in the cylinders, so that by opening or closing a valve connected thereto very fine speed regulation can be obtained. Some hoist builders today in building large new electric hoists apply a small compressor for like braking purposes.

A concluding article next month will complete the description of the installation at El Oro, and especially the hoisting outfit at the Somera shaft, which embodies some very interesting advances in practice as affecting the economy of electric hoisting machinery.

SYSTEMS FOR SIMPLIFYING SHOP SUPERVISION.

By Albert W. Thompson.

Dr. Louis Bell, earlier in this issue, suggests that there are dangers lurking in over-confidence in system and specialization. He is considering solely the physical product of the plant. But there are not lacking those who protest also against the over-indulgence in "systems" in the administrative work of the shop or factory—who have been surfeited with forms and cards and records until they find the burdens almost greater than the benefits. For the sake of such as these Mr. Thompson describes the sane, simple methods, almost self-operating, and the few forms, which he has found adequate in the conduct of the shops under his charge. It is a plan which has the record of success behind it.—THE EDITORS.

IN many small machine shops, whether engaged in manufacturing, repairs, or jobbing, the work is of such a nature that the manager, or superintendent, if he be a man possessed of an ordinarily good memory, is able to conduct the affairs of the shop without the aid of any other clerical assistance than that of his pay-roll clerk or book-keeper. As the business grows, the manager, growing with it in knowledge of detail, may still conduct it successfully without the aid of systems of reports or statistics, for he "carries them in his head." When he retires, however, his successor is confronted with a task of no mean proportions. His predecessor was the organization and the organization has departed with him; a new organization must be quickly supplied, and system is the only resource which the new manager can depend upon. The problem is often presented in this form, but under widely varying conditions, and the system must be designed to meet the requirements of each particular case.

In a large shop a good clerical force does not add a relatively large amount to the general expense, and a well organized department for estimating time on premium work is unquestionably a necessity, yet in a small shop such a department would be an extravagance. On the other hand, it would be absurd for the small shop to forego the advantages of premium work simply because it cannot afford an expert estimating department, and in this, as in nearly every case, the small shop must have a system designed to fit its own requirements. Generally speaking, the smaller the shop the greater the relative cost of clerical work; there are, nevertheless, many ways by which the burdens of the

supervising officers may be greatly lessened, and it is the purpose of this article to describe certain methods of this kind as applied in the machine shop of the Amoskeag Manufacturing Company.

The Amoskeag Company is engaged in textile manufacturing, operating 18,000 looms and employing 12,000 operatives, and the principal business of the machine shop is repairs for this large plant, and the manufacture of some lines of textile machinery for local use. For descriptive purposes the work may be classified as follows:

1.—Repairs by shop work, such as patching, re-fitting, etc., covering a large class of work which must be done in the shop.

2.—Repairs by spare parts, which can be replaced in the mills, the spare parts being furnished by the shop.

3.—Alterations, such as attaching warp-stop motions to looms, the parts for which are made in the shop and then put on in the mills by shop employees.

4.—Manufacturing, including the building of new machinery, and such apparatus as trucks, filling boxes, etc.

MACHINE SHOP ACCOUNT

Mill No. 4 — April 2, 1906

Weave Room

Repair Crank-shaft

Signed: W. L. G. Overseer.

Approved: Foreman.

Filled 19

No.

N.B.—Orders must be signed by Overseer and approved by Supt. of Shop. No new work will be done without approval of Supt. of Manufacturing.

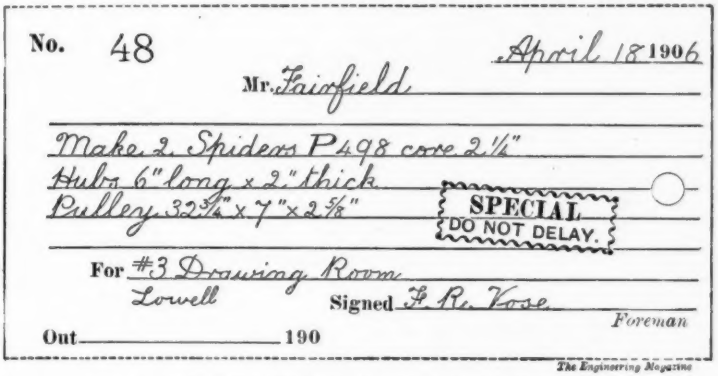
The Engineering Magazine

FIG. 1. OVERSEER'S ORDER FOR REPAIRS.
White-paper, 8 by 5¼.

The first class of work is of great variety, and offers no field for premium work, but being generally of a simple nature calls for foremen's supervision only, except that the more urgent cases require the attention of the superintendent to ensure prompt completion of work. The last three classes, however, involve the manufacture of duplicate parts in large quantities, affording a good field for the premium system and also demanding supervision to ensure proper routing of the

work through the several departments, and rapid completion in order of importance.

The foundry employs about 60 hands under one foreman, and the machine shop about 250 hands in six different departments, each under a foreman. To simplify supervision, therefore, and to aid foremen in giving proper precedence to different classes of work, some system plainly is required. To this end all work is done upon written orders, and each order is designated as "Rush," "Special," or


No. 48 April 18 1906

Mr. Fairfield

Make 2 Spiders P 498 core 2 1/4"
Hubs 6" long x 2" thick
Pulley 32 3/4" x 7" x 2 5/8"

SPECIAL
DO NOT DELAY.

For #3 Drawing Room
Lowell

Signed F. R. Rose
Foreman

Out _____ 190

The Engineering Magazine

FIG. 2. ORDER FOR REPAIRS, AS FILLED OUT IN SHOP OFFICE.
Thin yellow paper, 3 by 6 inches, in triplicate, perforated as shown for folding and tearing apart

"Routine," in order of importance. All orders are originally issued from the shop office, or are sent through the office from other departments for approval; supplementary orders for details are issued by foremen as required.

The form shown in Figure 1, is used by overseers in the mills in ordering repairs. Such orders are sent from the shop office to the proper foreman, if for routine work, or are held for the approval of the superintendent, if of an unusual nature. The form most used is shown in Figure 2, and is made up in triplicate by use of carbon copies. In using this form, one copy goes to the foundry or forge shop, one to the foreman who is to finish the work, the third being filed for reference by the person who writes it, if the work is routine. If for special work, each copy is stamped "Special," (See Figure 3) and the third copy is sent to the superintendent. Each foreman has a "special" stamp which he uses at his discretion, but generally,

only under orders from the superintendent. The "Rush" stamp is kept in the office, and is used only with the superintendent's approval, the third order copy going to the superintendent. These triplicate copies are kept in a special booklet, indexed for each department, so that the superintendent is thus provided with a constant memorandum of all important work in process in every department.

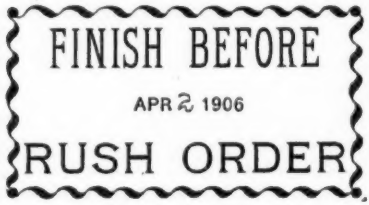


FIG. 3. STAMP FOR SPECIAL WORK. USED IN CONNECTION WITH FORM 2.

To further facilitate the course of important work, a tag is filled out and stamped to correspond with all "Rush" and "Special" orders, and is sent to the foundry with the order. When the casting is made it is sent to the shop with the tag attached, and as soon as received at the shop it is promptly delivered to the department indicated by the tag. In the case illustrated (See Figure 4) the tag furnishes the specifications for a wood-rimmed pulley. The order, bearing the same number as the tag, informs the foreman how many spiders of this size are to be finished, while the tags enable the operative to identify the spiders and give him the sizes to which they are to be bored, the same of course applying to the work of finishing the rims in the wood room. Little remains to be done in the way of supervision except for the superintendent to see that the work is commenced and completed to meet his requirements, which, with the order copies on file in his hand book, is a simple task, leaving little or nothing to the memory of any individual.

This system has given very good results, and the troubles which used frequently to arise from "side-tracking" prior to its introduction have now practically become unknown.

The manufacture of spare parts is conducted under the operation of a separate system which requires very little official supervision.

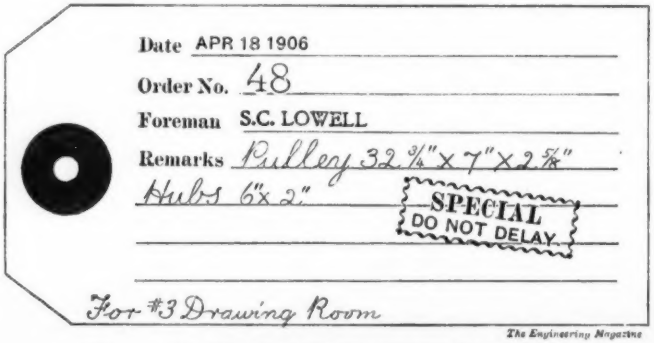


FIG. 4. TAG FOR RUSH WORK AND SPECIAL ORDERS.
The tag is distinguished by a bright blue color. It is shown with "rush" stamp affixed.

All finished spare parts are kept in stock in the stores department which has no connection with the machine shop. The stores keeper orders spare parts, according to his own requirements, usually several weeks ahead of the time when he expects a given supply to be exhausted, and "Store-House Orders" are therefore rarely urgent. Formerly, however, at times when urgent work was plentiful in the shop, the store-house orders were apt to be too long delayed, and would accumulate in the shop to an extent which caused much trouble and annoyance in all deparments. In order to obviate these troubles and to provide means for tracing individual orders, the following system has been adopted with very pleasing results.

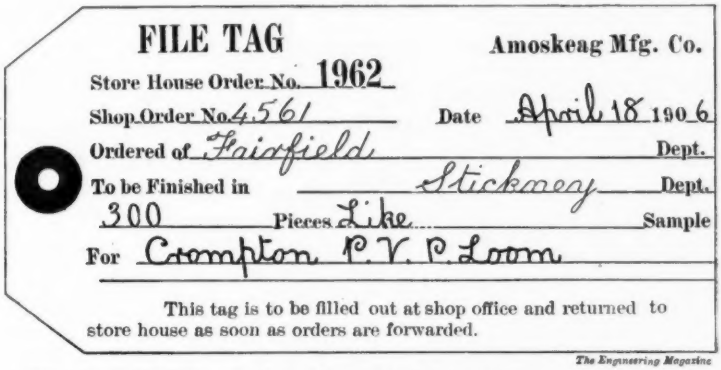

FILE TAG
Amoskeag Mfg. Co.
Store House Order No. 1962
Shop Order No. 4561
Date April 18 1906
Ordered of Fairfield Dept.
To be Finished in Stickney Dept.
300 Pieces Like Sample
For Compton P. V. P. Loom
This tag is to be filled out at shop office and returned to store house as soon as orders are forwarded.
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FIG. 5. FILE TAG. ATTACHED BY STORES KEEPER TO SAMPLE WHEN ORDERING SPARE PARTS FOR STOCK.

Partly filled out in his handwriting, and completed in the shop office. The tag is a plain manila stock. The "Sample Tag" and "Blank Tag" (See references just below on this page) are similar, except for name in the upper left corner; but the Sample Tag is brilliant yellow and the Blank Tag a vivid red

In ordering, the stores keeper sends a finished sample of the piece wanted to the shop office. To this sample is attached a "File Tag" (See Figure 5) which has been partially filled out, a corresponding entry having been made in the stores keeper's books. At the shop office a clerk finishes filling out the "File Tag," as indicated by the different handwritings in Figure 5, and fills out the "Sample" and "Blank" tags. A triplicate shop order is also made out, and one copy sent to the foundry with the sample, to which are now attached the "Sample" and "Blank" tags. A second copy of the order goes to the finishing department, and the third is filed in the shop office, a corresponding entry being made in the books. The "File" tag is returned to the stores-keeper. All interested parties now have a com-

STORE HOUSE ORDERS.

DATE	TAG	ORDER	MATERIAL	BLANKS OUT	FOREMAN	PIECES	FINISHED
Feb 22 1906	1027	4178	C. Iron	Mar 15, 1906	Stickney	50	Mar 14, 1906
Mar 14 "	1069	4261	C. Iron	" 30 "	"		
" 14 "	1071	4262	C. Iron		Clement		

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FIG. 6. HEADING, RULING, AND SAMPLE ENTRIES IN SHOP BOOK FOR STOCK-ORDER RECORDS.

The original is 8½ inches wide, ruled in red and blue.

plete record of the order which fully outlines its course through the various departments.

When the first lot of blanks from the foundry is delivered, the original sample, with "Sample" tag attached, is sent with them to the finishing department; the "Blank" tag is attached to a blank and retained at the foundry until all required blanks are made, when it accompanies the last lot to the finishing department. Each lot of blanks delivered is entered on the back of the "Blank" tag, and these entries should tally with the entries made for each lot of blanks received, on the back of the "Sample" tag by the foreman of the finishing department. In case the stores keeper runs short of stock before the completion of an order, small deliveries are made direct to the mills, and all deliveries from the finishing department are therefore

entered on the back of the "Sample" tag. When the final delivery of the order is made, the original sample and tag are sent to the stores keeper, who signs the tag and returns it to the shop office, thus receipting for the completion of the order.

When the blanks are all out of the foundry the foundry order copy, with the number and weight of castings made entered on its face, is returned to the shop office, and by means of the tags returned from the store house, the shop office is thus advised of the completion of each stage of the order. Corresponding entries made in the shop books (See Figure 6) indicate the progress of all orders in process. To guard against accumulation of unfilled orders in any department, a monthly statement is made out for each foreman, which explains itself. (See Figure 7.)

In description this system may appear complex, but in operation it is extremely simple, and the clerical work, being distributed through several different departments, is scarcely noticeable. The samples and blanks, with their colored tags, are kept on special shelves, and thus present to the eye of the foremen and superintendent a constant index of the state of this class of work in each department.

In an earlier contribution to THE ENGINEERING MAGAZINE, I have given a description of the method then in use in this shop for conducting a premium system in conjunction with regular or day work. This system has been conducted with uniformly good results, with but one radical change in method, namely the adoption of the Rowan system of determining premiums in place of the modified form of the Halsey system which was formerly used. Under the Rowan System, to earn a premium in excess of his regularly hourly or daily wage, the workman is required to complete each piece at the rate of less than (t) minutes. If in total time (T) minutes he completes (N) pieces he will receive, in addition to his regular wages a bonus or premium of minutes, paid for at his usual rate, expressed by the formula:

$$1 - \frac{T}{tN} T$$

Thus, if a workman in 10 hours finishes 60 pieces, the stipulated rate being 12 minutes per piece, his premium is:

$$\left(1 - \frac{600}{12 \times 60}\right) 600 = 100$$

minutes, or 1 2-3 hours. This is of course equivalent to a premium of 16 2-3 per cent paid for an increased production of 20 per cent. By the same system an increased production of 25 per cent earns 20 per

cent, and 100 per cent earns 50 per cent. Up to 100 per cent, or doubled production, the earnings under this system exceed those under the Halsey system on a 50 per cent basis. At doubled production the two systems pay the same premium, but beyond this point earnings under the Rowan system fall below the Halsey system and approach 100 per cent or "double time" as a limit.

The reasons for the adoption of the Rowan system are as follows: In many cases, notably in wood working and in performing simple machine-tool operations on large numbers of small parts, the rate of production depends more upon the manual dexterity and industry of the operative than upon the time required for the actual machining operations. In such cases accurate estimation of time is extremely difficult, as speeds and feeds become minor factors in the equation. Consequently, under the Halsey system, unreasonably large earnings would sometimes result even where estimates were carefully made from the best data at hand. Under any premium system, large earnings always represent a diminished cost of production and are therefore, in a sense, not a direct loss to the employer; nevertheless, if unreasonably large they endanger the harmonious working of the system as they are sure to cause dissatisfaction among the less fortunate operatives. Unreasonably large earnings, then, must be avoided, but never by any means unfair to the operative, such as cutting rates —an expedient which is dangerous in the extreme and which has never been resorted to in this shop. The Rowan system solves this problem by paying a high rate for small increases, thus recompensing the workman if the estimate has been too closely made, and by paying a lower premium for very large increases, thus protecting the employer from the evil results of too liberal estimates. In my opinion this system is by far the best for shops in which the volume of work does not warrant the maintenance of a special estimating department, or where the nature of the work is such that estimating is abnormally difficult. Its only objectionable feature is that it puts a premium on loose or careless estimating, but proper supervision should guard against this and all such defects.

Premium work in connection with day work has one great advantage which seems to escape general recognition, namely that a man engaged part of the time on day work and part on premium work is in reality on premium work all the time, for the increased earnings possible on the premium work, which he knows awaits him, stimulate him to complete his day work as rapidly as possible. This

Amoskeag Manufacturing Company

MACHINE SHOP

APR 2- 1906 190

Mr. M. L. STICKNEY

Your department should finish and deliver the following orders before May 1st next.

4061-992
4066-997
4131-1012

The following orders, now overdue, must be completed and delivered within same time ***WITHOUT FAIL***. If delivery is doubtful in any case, notify me at once.

3792-906
3824-913

Return this notice to my office on or before April 30th next, checking off each order completed, and furnish a memorandum of condition of any orders not filled as above specified.

Supt.

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FIG. 7. MONTHLY STATEMENT OF PENDING ORDERS. MADE OUT BY SHOP OFFICE AND ISSUED TO FOREMEN.

Original is a card 5½ by 8 inches.

MACHINE SHOP

Contract Labor Statistics

Payment Ending March 24 — 1906

FOREMAN	CONTRACTS NUMBER	TIME HOURS	ALLOWED HOURS	AVERAGE DURATION HOURS	AVERAGE PRODUCT PER CENT	AVERAGE EARNED PER CENT	BEST PRODUCT PER CENT	BEST EARNED PER CENT		
Stickney	38	1126 30	370 49	29 37	149.05	132.91	200.0	150.0	2 23/60	hrs.
Vose	22	1629 55	536 40	74 04	149.07	132.92	192.85	148.4	8 58/60	hrs.
Clement	1	39 10	10 04	39 10	134.58	125.70	134.58	125.70	10 4/60	hrs.
Blanchard	4	89 10	26 47	20 47	147.49	132.20	155.23	135.58	17 3/60	hrs.
NET RESULTS	65	2878 45	944 30	44 17	148.80	132.80				

Signed _____

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FIG. 8. REPORT OF MAXIMUM AND NET RESULTS OF PREMIUM WORK.

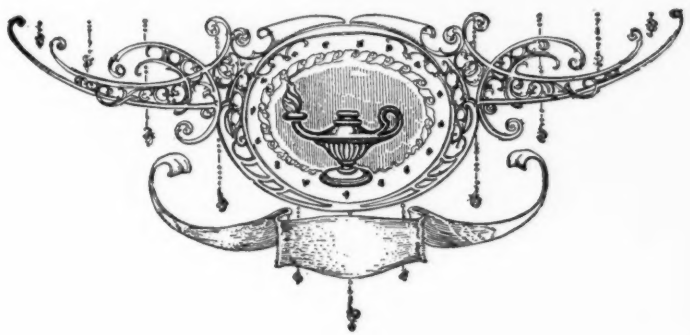
The last column gives the duration of the contract on which the best earnings were made in each department.

circumstance works to the advantage of both employer and operative, and from experience I am assured that it is by no means a theoretical advantage; for, in departments where both systems are used, the day work proceeds with much greater diligence on the part of the operative and much less "driving" on the part of the foreman, than was ever attained before the introduction of the premium system.

The net results and maximum results of premium work are easily traced by a simple report made out at the end of each payment for the inspection of the superintendent. (See Figure 8.)

The beneficial effect of the premium system in simplifying shop supervision is indubitable. The amount of time required of foremen for estimating and inspecting is quite appreciable, it is true, but for every hour spent in this manner, two were formerly spent in "driving" the help to maintain a production not nearly as good, while the difference in time expended is now available for proper supervision, improvements in method, etc.

I believe that in any shop where the problem is approached in a spirit of fairness both by employer and employed, no real difficulties exist which make the use of the premium system impracticable. Tentatively and carefully introduced, with a few men of known reliability, the time should soon come when all will ask for premium work instead of avoiding it, and its success is then assured.



MACHINERY AND PROCESSES IN A MODERN PORTLAND-CEMENT PLANT.

By F. H. Lewis.

I. THE PURSUIT OF ECONOMY IN KILN PRACTICE.

We pointed out recently (in connection with Mr. Eckel's article upon "Cement Production and Manufacture in the United States", which appeared in this Magazine for February last) that the enormous expansion of the cement industry was one of the most significant things in the engineering progress of the times. It is intimately related to the growth of the steel industry, and reflects a revolution in construction methods. Mr. Lewis' theme is principally concerned with the parts played by the metallurgical chemist and the mechanical engineer in enabling this phenomenal development.—THE EDITORS.

IN dealing with this subject reference will be made entirely to the rotary kiln and to American methods—which are rapidly becoming European methods.

The principal raw material used by a cement kiln is atmospheric air. To produce a barrel of cement by the dry method requires 600 pounds of ground rock, 110 pounds of powdered coal, and about 2,000 pounds of air. Of this air only about 260 pounds actually contributes to the generation of heat. The balance is inert matter forming part of the gaseous contents of the furnace. It must be raised to the clinkering temperature of cement by the combustion of fuel, exactly as the ground rock is. As the specific heat of air is not very different from that of the cement composition, this means that the air takes up rather more than two and a half parts of the heat generated by combustion to one part taken up by the raw material proper, and in a rotary kiln it does not yield this heat again to advantage. A part of the whole amount of heat generated is also lost by convection and radiation, and as a net result in ordinary practice less than one-fourth of the heat generated in a kiln is used in clinkering the cement composition.

This statement, too, must be understood as a practical fact. It has no reference to the theoretical value of the fuel, but to the distribution of the heat as actually utilized in kiln practice. There appears, therefore, to be an enormous practical waste of fuel. A part of this, however, is inevitable. So far as combustion proper is concerned analogous results are obtained in boiler and other furnaces by reason of air dilution. But in a rotary kiln this great volume of heated gases

is very badly utilized. Something like 45 per cent of the total heat passes off with the flue gases, while about 12 per cent more passes out at the lower end as the sensible heat of the clinker. Hence this type of kiln requires twice the fuel which is necessary to burn clinker in the best types of continuous shaft kilns.

If all this waste heat could be utilized it would generate 70 per cent of all the steam power required by a cement plant. Or it would heat all the air entering the kilns to an initial temperature of 1,800 degrees and cut the fuel bill in half. It cannot all be utilized, of course, and the advantages of the rotary kiln in other respects are such as to make it advantageous in many places, regardless of the waste of fuel. But this great by-product of unused heat cannot be overlooked if economy of production is to be fully developed; nor indeed has it been, as will appear below.

As other by-products of cement manufacture, for each barrel (380 pounds) of clinker produced, there is given off from the chimney 440 pounds of carbonic acid, 10 pounds of sulphuric acid, and 6 pounds of potash and soda. These by-products exceed in weight, and if they could be utilized would exceed in value, the primary product of manufacture.

All human endeavor proceeds by methods of trial and error. Seldom is a proposition approached first-off, either logically or advantageously. We learn by a series of mistakes, and there are few pieces of machinery which have developed through a more conspicuous series of blunders than the rotary kiln. Neglecting its early history in England and America, which has been so often recited, we find it in successful operation at two plants in the United States in 1892. These were the Atlas plant at Coplay, Pa., and the Alpha plant at Alpha, N. J. By successful operation, I mean that the kilns were regularly producing an excellent product. Commercially it is doubtful whether they were satisfactory even at the high scale of prices of those days. These kilns were small and the fuel was crude petroleum. It required from 10 to 15 gallons of oil to produce a barrel of cement, and the clinker, while of superior quality, was much more difficult to grind than the old-style product.

Immediately we find attention being given, not to better means of utilizing the heat, but to utilization of the by-products, to wit, the waste heat and waste gases. Mr. J. F. deNavarro of the Atlas Company took out a series of patents for this purpose. Figure 1 is an illustration taken from patent No. 11,224 issued to J. F. deNavarro in 1892. It provides for all the usual features of a rotary kiln shown

in the upper part of the drawing, and in addition for a revolving cooling cylinder below the kiln. This cooling cylinder enters the hood which closes the lower end of the kiln. The specification recites: "By causing the air to pass over the heated product in the cylinder G while the said product is kept in motion, the material is

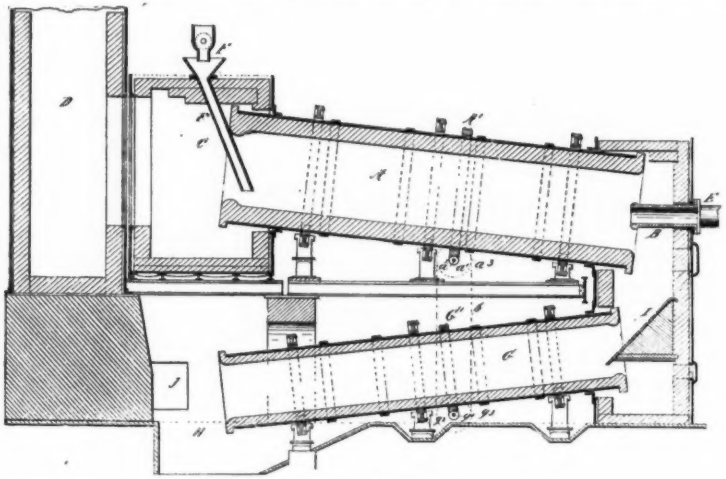


FIG. 1. DE NAVARRO'S PATENT OF 1892.

very effectively cooled and the waste heat abstracted from it is used to the best effect in heating the air supplied to the furnace." It is an attempt to utilize the waste heat of the clinker, which at that time probably did not exceed 8 per cent of the whole.

Figure 2 is taken from patent No. 457,589, issued to Mr. de Navarro in 1891. In addition to the features shown in Figure 1 it has a hot-air stove in the dust chamber at the upper end of the kiln. Air passes

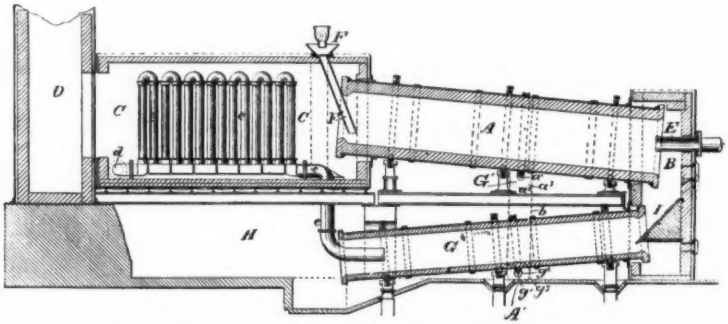


FIG. 2 DE NAVARRO'S PATENT OF 1891.

first through this stove, then to the cooling cylinder, and thence enters the kiln. This device endeavors to utilize both the waste heat of the chimney gases and the heat of the clinker. So far as is known these devices effected no economy in fuel worth considering. The cooling cylinder was doubtless a good thing. We find it developed further in a patent granted in 1895 to Messrs. Hurry and Seaman (also of the Atlas Cement Co.), shown in Figure 3. This has the cooling cylinder of Mr. de Navarro's earlier patents, but is a clinker-cooling device pure and simple. The hot clinker drops onto water-cooled rolls which break it up; thence to the cooling cylinder, where more water can be added if desired. An endeavor is made to make an air-tight connection between the cooling cylinder and the hood so as to perfect the draft, and provision is made for an artificial current of air in the cooling cylinder by means of a fan. Nothing is claimed for fuel economy and the fan is not used to supply air for the kiln. This patent is no doubt a valuable one for clinker-cooling purposes, and is a feature of large plants built by the Atlas Company in later years.

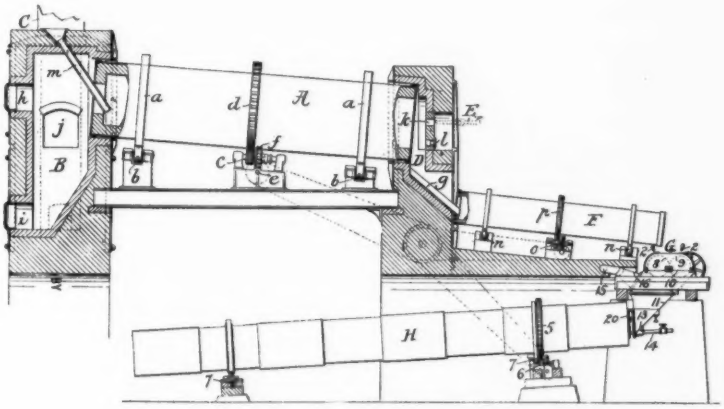


FIG. 3. HURRY & SEAMAN'S PATENT OF 1895.

In 1896 Mr. deNavarro took out a patent for utilizing the carbonic acid from cement stone. Figure 4 is from this patent (No. 560,742). The carbonic acid is driven off by a retort furnace and collected in a condenser chamber T before the material goes to the kiln proper. So far as is known, neither this patent, nor others taken out with like intent by various individuals, has had any practical value.

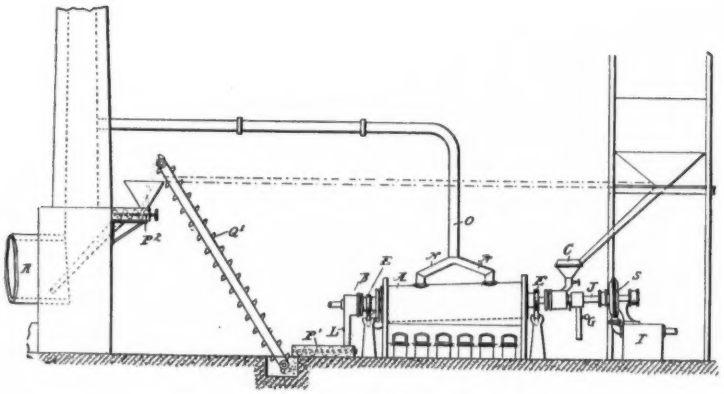


FIG. 4. DE NAVARRO'S PATENT OF 1896.

In 1896 a plant was built at Nazareth, Pa., in which an ambitious attempt was made to utilize the waste heat of the flue gases for generation of steam. From the dust chambers of the kilns the flue gases passed directly to vertical water-tube boilers which furnished steam for engines driving the grinding mills. Seven kilns were installed in this way. There was not, of course, sufficient waste heat to generate the steam required, so auxiliary firing of the boilers had to go on continuously. This interfered with the draft of the kilns and greatly reduced their output. The fire-room labor was as expensive as ever, the fuel saving small, and the plant produced neither clinker nor steam satisfactorily. A new steam plant was built, the old boilers were taken out, and the kilns were provided with independent stacks as usual.

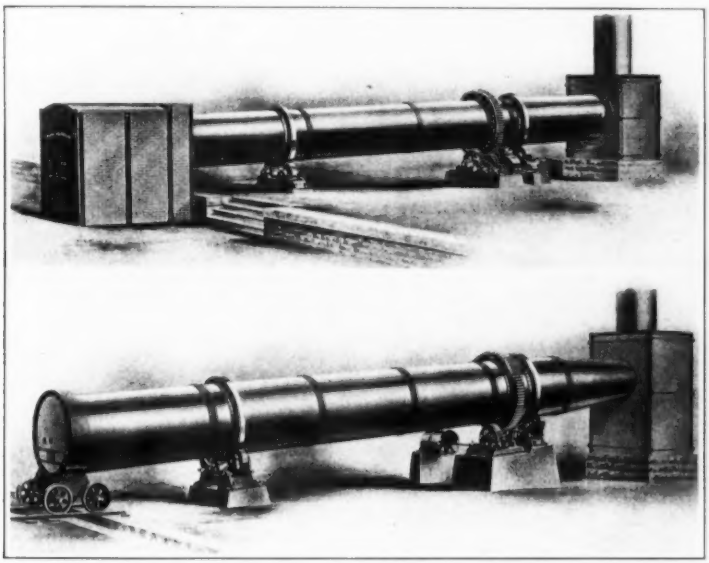
An attempt was made by me in 1898-99 to draw off kiln gases and utilize them for drying stone, but the conditions were unfavorable and little or no advantage resulted. Later, in 1904, the Lehigh Portland Cement Co. equipped a new plant with this scheme. Four kilns out of ten were arranged to discharge the flue gases from the dust chamber into auxiliary cylinders in which the stone was dried. The arrangement complicated the handling of stone considerably and increased the fuel consumption of the kilns. The advantage, if any, was so inconsiderable that the experiment has not been repeated.

A variety of devices have been tried for heating the air which carries the coal feed. This has been done both by passing the air through the hot clinker and by heating it in the dust chamber. No important advantage has been gained in this way, and in some cases

the installations were so unsatisfactory that it was imperative to take them out.

The heat of flue gases has also been utilized in several plants by installing economizers in the dust chamber or at the base of kiln stacks. Whether or not any advantage has been gained over the usual practice of placing the economizers in the boiler stacks I am not advised. The disadvantage which has been a feature of nearly all the devices described above is that they complicate the kiln plants proper and gain advantage in other respects by inconvenient arrangements badly placed for the work required of them.

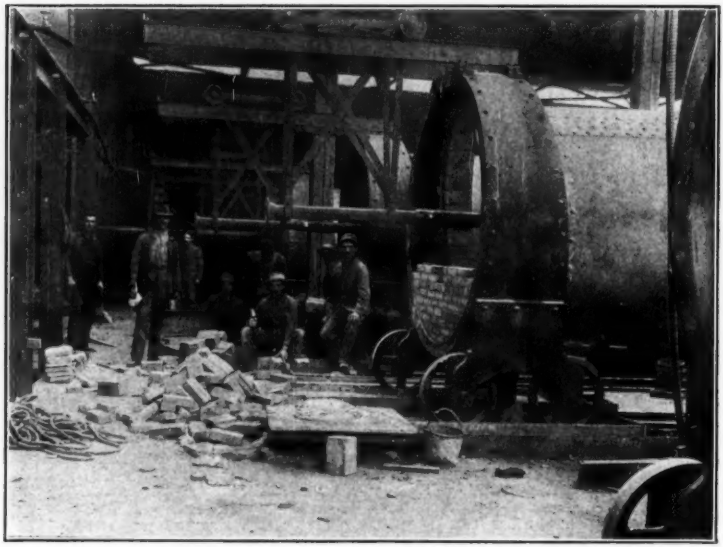
Lastly, the advantages and disadvantages of collecting by suitable devices the alkaline vapors in kiln gases have been discussed in the chemical societies and apparently found to be an interesting topic. An ordinary ten-kiln plant discharges five or six tons of potash and soda into the atmosphere daily. Can this be collected economically without disadvantage to the kilns? Undoubtedly someone will make the attempt before long and may succeed. But as a rule, those best posted are willing to let someone else do the experimenting.



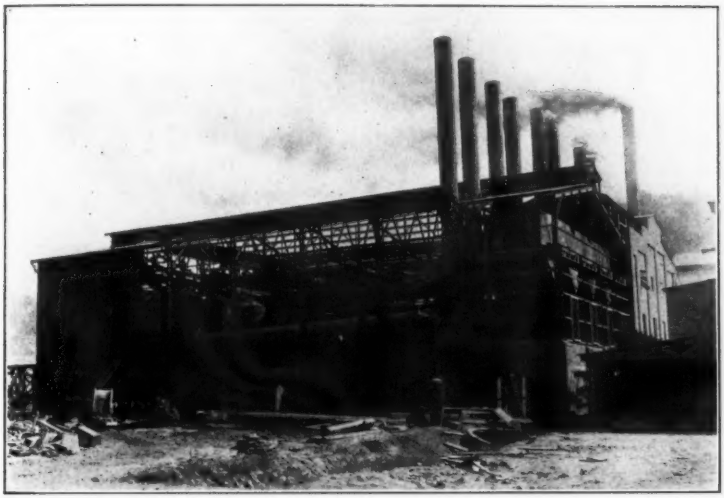
MODERN TYPES OF ROTARY KILNS AND DRYERS.
The dryer above, the kiln below. Allis-Chalmers Co., Milwaukee, Wis.

It will be noted that the minds of most men have been devoted more to the utilization of heat as a by-product than to using it most advantageously in the primary operation, to wit, the production of clinker. It is true kilns have been gradually improved and perfected, made larger and longer, equipped with better feed devices, etc. But we have been slow to adopt the principles found advantageous in other forms of furnaces and have found it difficult to shake loose certain ideas long considered essential by cement makers. For example, the necessity for an oxidizing flame in the kiln and the supposed necessity for a clinkering zone of very high temperature to form the tricalcic silicate so much insisted upon by doctrinaires. We know that in boiler practice, to get out the heat developed in the furnace we must have adequate heating surface. In a metallurgical furnace economy results from a long flame and a high flue-bridge (or a small opening over the flue-bridge). We have been slow to learn similar practice in a cement kiln.

The old rotary kiln was 5 feet in diameter and 40 or 45 feet long. It was set at an inclination of ¾ inch to 1 inch per foot, and revolved very slowly. The heating surface was small because the area in contact with the heated gases was so limited, and because of the steep



CEMENT KILNS UNDER CONSTRUCTION. THE LOWER OR BURNER END, WITH BRICKWORK FOR HOODS IN PROGRESS.

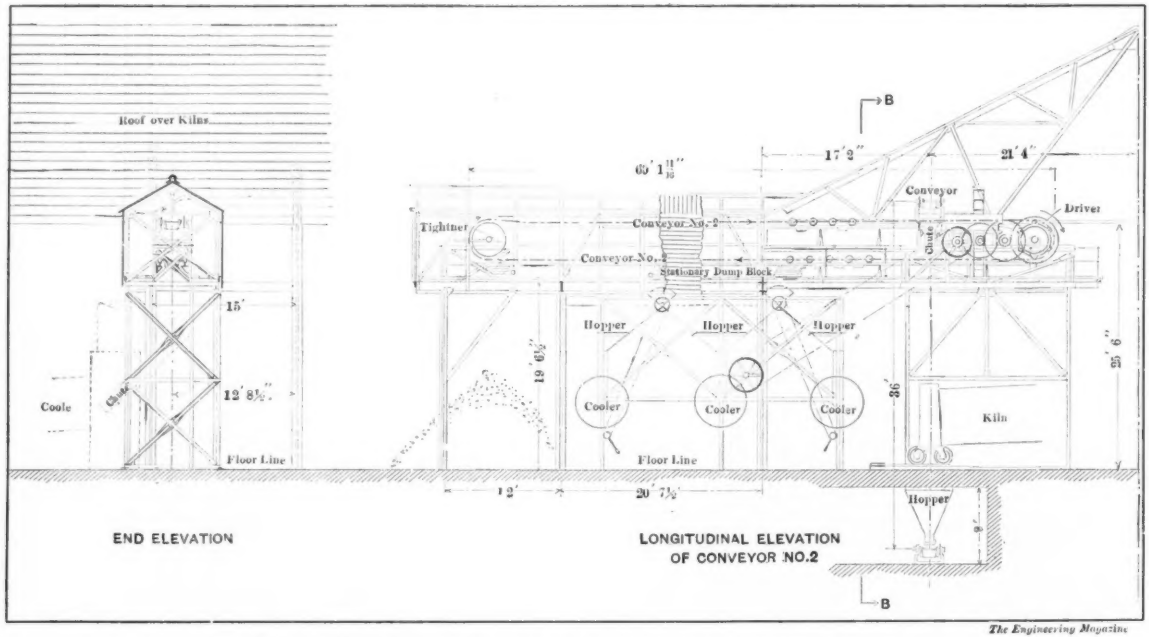


A KILN HOUSE IN PROCESS OF ERECTION.

The Kilns are 6 by 60 feet. Stock boxes and coal tanks plainly shown. Plant of the Virginia Portland Cement Co., Fordwick, Va.

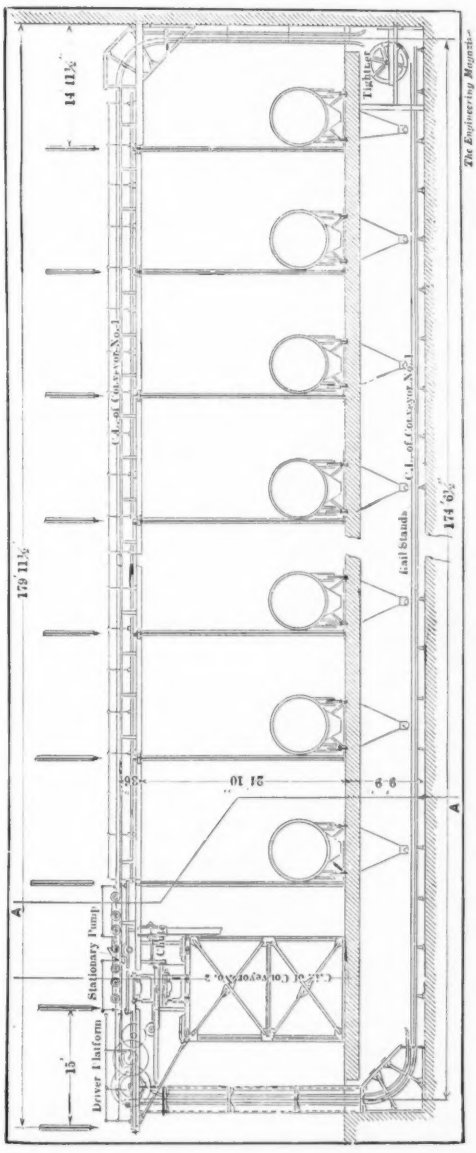
pitch and slow speed the material was not brought sufficiently in contact with the hot gases. Impressed with this latter point, I designed and built kilns for two different plants in 1899 which had only ½ inch pitch per foot and 50 per cent greater speed of rotation than usual. This meant that in passing through the kilns the material was 50 per cent longer in contact with the heated gases than in the old kilns; its forward movement was the same while the rotating, stirring, or tumbling motion was more rapid. Kilns are now being built with ⅜ or even less pitch and correspondingly greater speed of rotation. They are being built larger and longer to provide additional heating surface, lower pitch, and greater speed to bring the material more often in contact with flame and hot gases.

We are revising our ideas somewhat also on chemical reactions. Assuming properly prepared raw materials practical experience leads us to believe that the production of Portland-cement clinker is merely a question of subjecting this material to a sufficient degree of heat for a suitable interval of time. Heat and time vary with different materials; for any given material they vary inversely to each other. The temperature limits may vary between 1,700 degrees F. and 3,300 degrees, and the time required for satisfactory chemical reaction may be of indefinite extent or it may be instantaneous. Lime and silica



GENERAL ARRANGEMENT OF PLANT OF ALPHA CEMENT CO., MARTIN'S CREEK, PA.

Showing especially the run of the 18 x 24 inch conveyors as installed by John A. Mead Mfg. Co. For section B B see the diagram opposite.



PLANT OF THE ALPHA CEMENT CO. FOR SECTION AA SEE THE DIAGRAM OPPOSITE.
Installed by John A. Mead Mfg. Co.

will combine superficially at ordinary temperatures. Lime will combine more or less perfectly (depending on mechanical contact) with any clay which has been heated to redness. In a Portland-cement kiln we have an intimate mixture of carbonate of lime and of clay. The clay becomes chemically active at about 1,100 degrees F. The carbonate of lime yields up its carbonic acid and becomes quick-lime at 1,700 degrees. Combination between the two materials is found to begin the moment quick-lime finds itself in contact with chemically act-

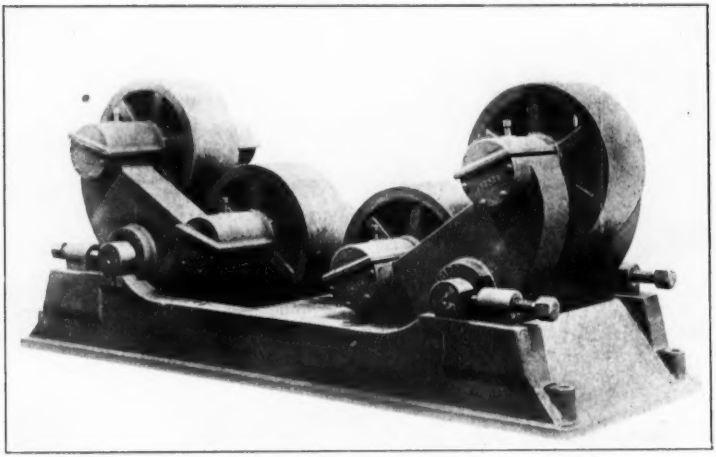
KILN ROOM, CEMENT PLANT NO. 3, ILLINOIS STEEL CO., BUFFINGTON, IND.
Rotary Kilns installed by the Allis-Chalmers Co.

AUTOMATIC SELF-REVERSING TRIPPER, DISCHARGING GROUND CLINKER TO BINS.

Installed at the plant of the Alpha Portland Cement Co., by the Robins Conveying Belt Co.

ive clay. The higher the temperature the more rapid the combination. At the temperature of an electric furnace it is fair to conclude that it would be instantaneous. At a uniform soaking heat the time required increases as the temperature decreases, but nevertheless goes on progressively at lower temperatures than were formerly considered necessary.

We do not discuss so much whether the formation of tricalcic silicate is necessary or whether it is not. If it is necessary, then we form it, but we do it somewhat differently from the way in which we have been told we should. Practical experience shows that at comparatively low temperatures chemical unions are formed which are hydraulic, and that with higher temperature or more prolonged baking these combinations become more perfect and exhibit greater chemical activity.



CARRYING MECHANISM WITH FOUR ROLLERS AND EQUALIZERS FOR ALLIS-CHALMERS ROTARY KILN.

Two things enter a rotary cement kiln; raw material in a fine state of subdivision at the upper end, powdered coal at the lower end. The one product of the kiln is cement clinker. Its by-products are the sensible heat of the clinker, the waste heat of the flue gases, the carbonic acid, sulphuric acid, and alkalies carried off with the flue gases. It may yet be that important advantages will be gained by utilization of by-products. It is only fair to say, however, that the results of experiments, up to this time, are distinctly discouraging. The modern cement-maker pins his faith to better utilization of heat to obtain his primary product. More heating surface, more frequent contact of material with heated gases; a larger kiln, a longer kiln, a long flame and a soaking heat. These things are yielding more output, better cement, and more economical product.

ORGANIZATION AND ECONOMY IN THE RAILWAY MACHINE SHOP.

By H. W. Jacobs.

I. SPECIALIZING AND CENTRALIZING THE OPERATIONS AND EQUIPMENT.

Because the railway shop is not competitive, it has been slow to feel the pressure for lowered expense of production. It did not have to measure its costs against energetic and alert business rivals. Lately, however, there has been a great awakening, and some of the large American Transcontinental roads have gone as far perhaps as any commercial establishment in studying to bring their work down to a minimum cost per unit.

Mr. Jacobs is one of the leaders in this movement, and the methods he describes have been tried out in the shops of one of the greatest Transcontinental lines. Everything he suggests is practical—the result of thorough trial and perfection under working conditions. And in the following papers especially, his illustrations tell a story as valuable as that of the text.—THE EDITORS.

RAILROADS in the United States perform the functions of common-carriers and of money-makers. As carriers, besides their relation to the land and the people, they must be adapted to the trade of their territory and connections—in facilities, capacity, and operative efficiency. As the property of private persons, they must be managed and operated to effect the greatest ratio of net earnings to investment, besides conforming to the compulsions of the law, and to their own interests in commerce. Men trained as engineers in both the schools of induction and of practice, are as a class best able to bring about these results, as their work is constructively directed toward the end in view after intelligent analysis of actual conditions. We shall deal with some concrete problems of the engineer in relation to the maintenance of operative efficiency of the motive power and rolling equipment—those most active factors of earning power and expense in existing steam roads.

To move the traffic of a road, locomotives and cars are required. These must be built, maintained in running order, repaired, replaced, and must be designed with reference to safety, efficiency and operative economy, cost, adaptability, durability, simplicity and interchangeability of parts, and facility of repairs.

Whether a road builds its own equipment or not it has a large voice in specifying design, and it must keep up the running condition; these functions require both the mechanical and the industrial engineer.

Great manufactures, such as the steel industry, have been successful on a large scale. The methods under which they thrived are applicable wherever there are manufacturing shops. Railroads have been slow to modernize their shop methods and to refine their mechanical practice, because the chief spur is to earn dividends by means of transportation. They are only very indirectly affected by the forces governing competitive and economical manufacture in commercial enterprises, and less indirectly by the forces making for greater serviceability of equipment. But if the experience of the commercial manufactories is profited by, and modern methods adopted wholesale, modified to suit such conditions as may be peculiar to railroads; if the improved products, developed at such cost in the commercial world, are but taken as they are found, and used effectively, great improvements in operative and maintenance efficiencies and economies will ensue, resulting in the two-fold gain of lowered running cost and fixed charges, together with capacity for handling larger business, with greater gross, and redoubled net, earnings.

All this is not mere argument, but is demonstrated by actual instances, late and near at hand. The management of the roads are waking up to these capabilities and rapidly availing themselves of them. Cast steel and malleable iron are substituted for cast and wrought iron, wherever they may with advantage be used. Patterns are redesigned, reclassified, and standardized, many being obsoleted, surplus of material being done away with both on account of the needless higher first cost of the casting, and the increased time of machining; bolt holes are cored so as not to require drilling, and design is strengthened to take care of weaknesses shown by exhaustive records of all classes of breakage to parts of motive power and rolling equipment; locomotive and car elements are standardized as far as practicable, and new equipment is ordered to conform to these specifications. The Harriman lines and the Rock Island have been conspicuous examples of such standardization, broadly conceived and comprehensively carried out.

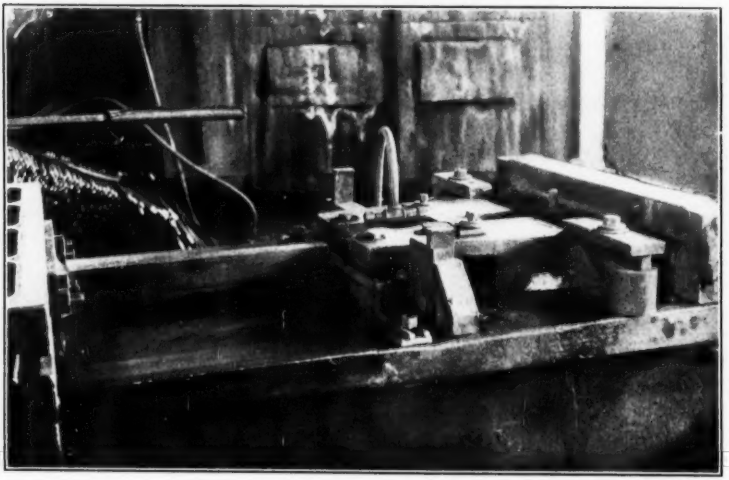
Tests are becoming more thorough and less perfunctory, and as a result, design is continually changing for the better. Not only is there thus a general tendency toward improvement in quality and efficiency of equipment, but there is also a growing determination to provide the very best shop facilities for taking care of repair and replacement, as at the Moline (Rock Island), Topeka (Santa Fé), Collinwood (Lake Shore), Omaha (Union Pacific), and other large recent shops. And in these shops, centralized, large, there is a

growing effort toward intelligent systematization of manufacture, toward rapid production at low cost, and toward using men and machines to full economical capacity.

The direction in which the railroads are slowly moving is the right one; this paper advocates some of the means by which these results can be attained in a still larger way.

In the first place, salaries and wages are too low. I am no advocate of increased pay rolls. But it is shown in practice that five men worth $4.00 a day each can do as much as ten $3.00 men, and the same is true of a foreman earning $80.00 or $90.00 compared to one earning $150.00 to $200.00; or of an official belonging to the $200.00 class compared to one belonging to the $600.00 class. The high-priced man is not necessarily the best; but for the high price the best can be secured. It is manifestly false economy to pay a master mechanic $175.00 a month, and give him charge over one thousand or two thousand men with an aggregate pay roll of $60,000 to $100,000, when an intelligent $300.00 man, bringing perhaps in his train a $500.00 staff of assistants and specialists, can in six months lop off 15 to 30 per cent of this pay roll, and at the same time by system and specialization and a method of reward according to merit, give increased and better service. Similarly, a $90.00 foreman is not an economical man to whom to entrust the requisitioning of thousands of dollars worth of material each month; he will generally order perfunctorily and far beyond his needs, and it is not usual for his requisitions to be effectively checked up. There is, for example, the case of a road that had but two engines of one particular class, under experiment, which they would transfer from one division to another to get figures on their service. After they had been in use about two years and had been overhauled in three different places, the president called for an itemized expense statement; and when the supplies were checked up at the different stores, there were found to be fourteen sets of grates, nine sets of cylinder-heads, four sets of pistons, two complete sets of rods, besides numerous cylinder-head casings, valve packings, piston rings, etc.—more stock, in fact, than these two engines would use in ten years of hard service. This is perhaps an unusual case, but it is actual, and no one was to blame but the system. Each foreman at the different points thought it was his duty to keep up the supplies, and in a sense he was right, as no one wished to score a failure while the engine was in his particular territory. But if the foreman had been a man of good judgment, he would have consulted the store-

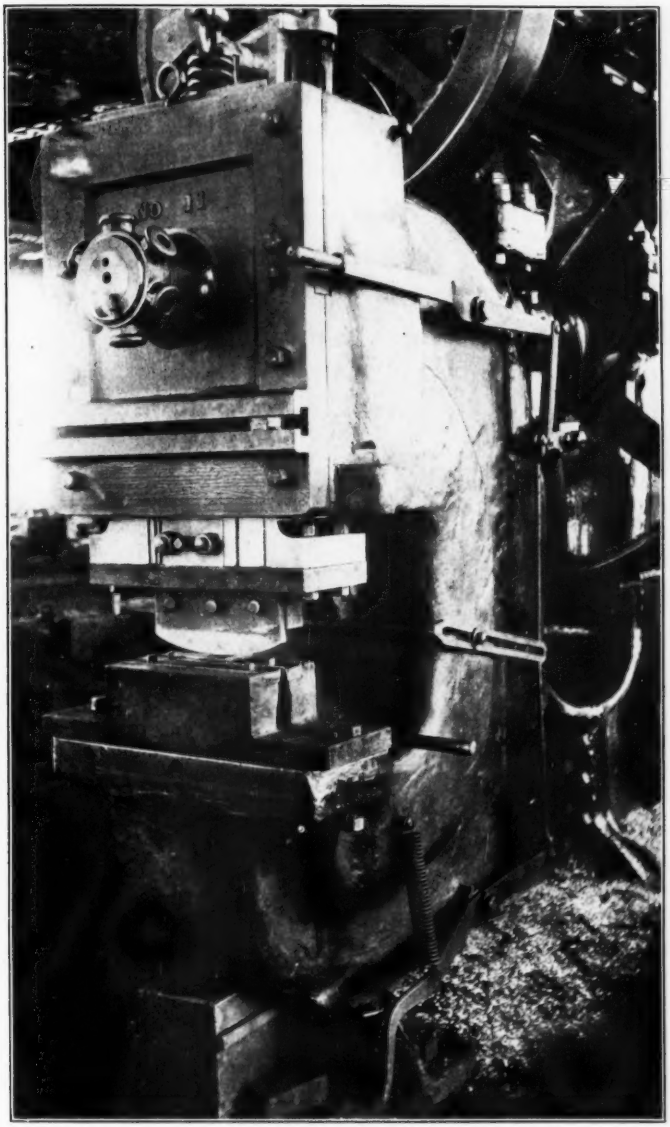
keepers and others before ordering indiscriminately, and if there had been higher officials who would not have let such a condition come into effect, but would have permitted the ordering only of what was necessary, and would have intelligently transferred the material on hand as became requisite, all this needless investment in new material would have been obviated. Multiply this case by the number of engines on a road, and perhaps cut the total in two on account of its being an exceptional case, and the prevalent condition on many a road today will be pictured. Plainly, almost no salary is too high if it will secure the prevention and correction of this sort of practice.



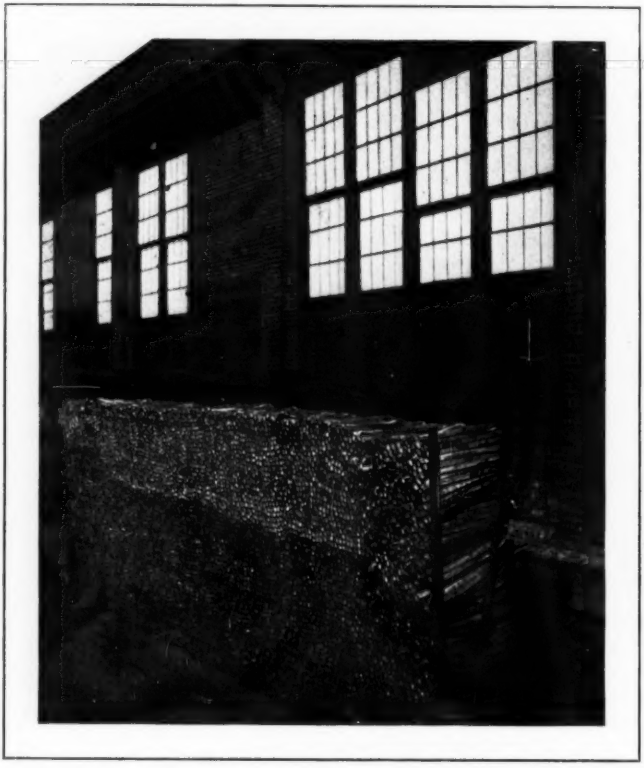
A BRAKESHOE-KEY FORGING MACHINE DEVISED BY A BLACKSMITH-SHOP FOREMAN.

Reconstructed from an old bull-dozer. It forges two keys at a time from scrap car bolts, turning them out by the thousand at very little cost, where formerly they were made laboriously by hand. With the enormous number of keys used on a railroad handling a large freight business, an item of this kind is well worth considering.

There is now and then in a railroad shop a foreman whose ideas are of a special merit, which, if encouraged, can be of thousands of dollars benefit to a company. Such is the case of the blacksmith foreman who designed the brakeshoe-key forging machine here illustrated. This machine was reconstructed from an old bull-dozer and forges two brakeshoe keys at a time from scrap car bolts. Whereas these keys used to be made laboriously by hand, they are now turned out by the thousand at very little cost. With the enormous number of brakeshoe keys used on a railroad handling an immense freight business, an item of this kind is well worth considerable attention.



SHEAR USED TO CUT APART THE TWO KEYS WHICH ARE FORGED TOGETHER ON THE MACHINE SHOWN ON THE OPPOSITE PAGE.



A FEW DAYS' WORK ON THE BRAKESHOE-KEY FORGING MACHINE.

Centralization, as applied to shop work in the railway world, is not exactly a new idea, although the subject has been more or less agitated by manufacturing concerns for years, and to this is largely due the success of some of our great modern trusts. But the development of this policy in railway lines is quite recent. The stride it has made in the immediate past, and which it is at present making among the railways of the United States, is worthy not only of comment, but of the serious consideration of every railway official who believes in "Economy and Efficient Service."

There are many things to be considered when taking up a proposition of this kind, involving serious and complicated problems which must be decided upon before a successful working basis can be established. First of all, should be considered the location of the railway

in question, its mileage and general lay-out, and particularly the location of the division points and headquarters, shops, etc., with reference to *the original base of supplies.*

It would not pay, for instance, for a straight overland line say of 1,500 or 2,000 miles in length, with good facilities, foundries, etc., at each end of the line, to decide to manufacture all of the material at some point near the middle of the line, where no foundry or other needed equipment was located. I have in mind a certain railway, whose machine shop was located near its western terminal; its largest car shop was a little farther east, and it bought its wheels from a foundry at its extreme eastern terminal. With the idea of centralization of work in mind, the people in charge ordered all wheels for car work fitted up at the western end. This caused all new wheels to be hauled through the point where the car shop was located, and then hauled back after being mounted. It also caused all old wheels to be sent west to be stripped, and then hauled back the entire length of the line, as scrap. This haul in freight alone, at ½ cent per ton mile, cost $1,200 in a month, besides causing an extra delay of at least one day in delivery from the time the wheels left the foundry until the time when they were mounted and ready for the cars. Of course, the argument can be made that centralization was not at fault, but rather the location of the shop with reference to the base of supply. This is indeed true, and all this trouble could be avoided by relocating the shop; but this discussion is not intended to include the provision of new equipment; it is intended to confine the consideration to plans which will work with the present equipment of the road in question. There is not one railway in twenty now in a position to consider the rebuilding of all its shops, or even the relocation of its base of supply. We must deal with conditions as we find them.

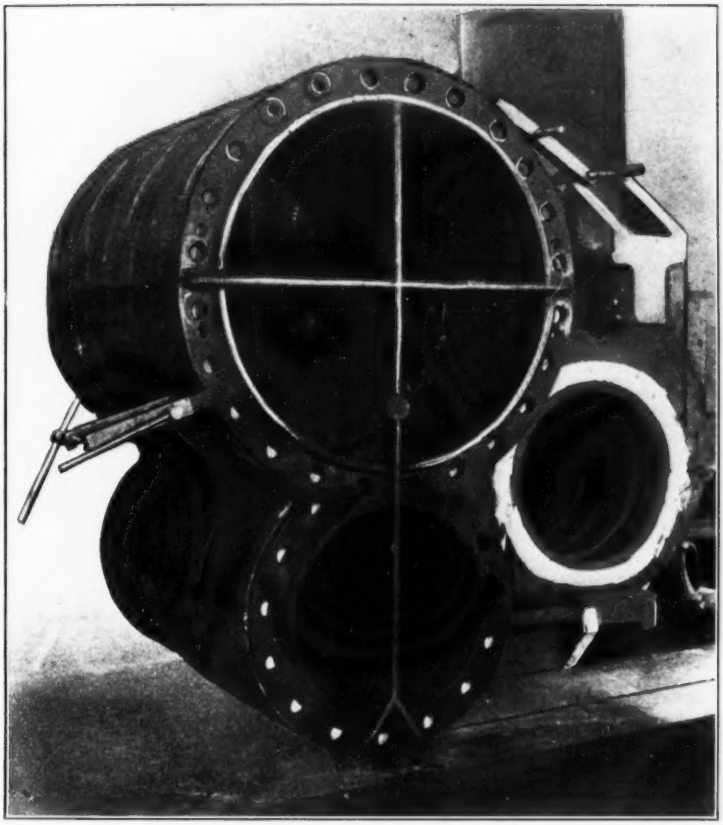
A shop that turns out finished material, whether it be pilots or petticoats, is a manufacturing concern or establishment, and must be recognized as such. It requires no large array of figures to prove that the larger the output of a given article, the lower will be the labor cost per piece. If a man can turn out six brasses, for example, in one lot at a given rate, it stands to reason that he ought to turn out twenty at one time at a reduced rate per brass. This is true of any other article needed in railway work. The fewer the changes of tools and settings to make, the less the number of tools to keep up, and the more familiar the workman becomes with each particular class of work, the larger are the opportunities for the reduction of cost. Centralization of work allows for the full development

of the specialist, which is the greatest factor in the labor end of production. With one main shop and a foundry in connection with it, the furnishing of material ready for service for all points comes in line as naturally as a wrapping department in a large mercantile house. There is an even and logical sequence of operations in the movement of the article from the foundry or furnace to its place of service. This method reduces the amount of stock to be carried, and consequently does away with all the expense of extra handling of stock, etc. It reduces the amount of tools, jigs, and machines required to get the stuff in shape for service. For instance, it requires a certain expensive machine, a set of jigs, angle plates, tool holders, etc., to prepare properly shoes and wedges, or driving boxes for use on an engine. If there are eighteen shops on the road where these are to be used, this calls for eighteen sets of tools, jigs, etc., for this particular article. With this job specialized and all done at one place, the chances are that one set of these tools, jigs, etc., would be sufficient to supply the entire equipment. Clearly, this would cut out seventeen no-longer-needed machines, sets of tools, angle plates, jigs, etc., besides the work and the men formerly required at each place, to fit up and keep them in good order. On one road where this was done, it has secured a reduction in the small item of maintenance of machinery and tools, of $180,000 per year.

The particular templet here illustrated saves hours of work in laying cylinders off for the stud and bolt holes and insures absolute accuracy and interchangeability, and if the cylinders are completely finished before sending out to a smaller shop, but the one templet is required.

A jig or tool in continuous action is a money saver, and there cannot be too many under these conditions. A jig or tool of any kind, lying idle, is so much "dead capital" or money lost. Take the basis of eighteen shops and eliminate seventeen sets of tools, plates, etc., for each special part of a car or locomotive, and the figures run away up into the thousands.

The illustration of knuckle-pin-hole reamers shows a case of a money-making tool. At the top of the pile (page 906) will be noted standard gauges. These are supplied to each shop and large roundhouse and a set of knuckle-pin reamers for the classes of engines dependent there. An engine comes in with a knuckle pin to be replaced; the hole is worn oblong; there are four of each nominal size of these reamers, varying from actual size to ⅛ inch above by thirty-seconds. The hole is bored out by the smallest reamer possible and standard



TEMPLET FOR USE IN DRILLING COMPOUND CYLINDER.

This saves hours of work in laying off cylinders for the stud and bolt holes, and insures absolute accuracy and interchangeability.

taper knuckle pins, completely finished and kept in stock, supplied from the general shop where centralized manufacturing is carried on, are applied. This process results in great economy of time in a round-house. The reamers are tried, frequently, by gauge, and when worn small are shipped in to the central tool-room for regrinding and re-setting of the cutting edges.

The solution lies largely in the hands of the supply department—more there than in any other. The hearty co-operation of the me-

SET OF STANDARD KNUCKLE-PIN-HOLE REAMERS, MANUFACTURED TO WITHIN .003 OF SIZE IN THE CENTRALIZED TOOL ROOM.

At the top of this pile of reamers will be noted standard gauges. These are supplied to each shop and large round-house and a set of knuckle-pin reamers for the class of engines dependent there. When a knuckle pin needs to be replaced, the hole is worn oblong; there are four of each nominal size of these reamers varying from actual size to ¼-inch above by thirty-seconds. The hole is bored out by the smallest reamer possible, and standard taper knuckle pins, completely finished, and kept in stock, supplied from the general shop where centralized manufacturing is carried on, are applied. This process results in great economy of time in a round house. The reamers are tried, frequently, by gauge and when worn small are shipped in to the central tool room for regrinding and resetting of the cutting edges.

chanical department is an absolutely necessity, but the supply or store department should be the prime mover. It is the store department that should furnish accurate figures, annually, monthly, or on some periodical basis of consumption, as it is through this method only that the stock can be kept alive at all times. "Live" stock and its proper care, is fundamental to the entire railway-supply business.

The store should have absolute figures on engines and cars, according to class and location, with a full set of pattern books and forgings, planing-mill lists, etc., right up to date, at all times. Records

of tire wear, journal wear, fire-box conditions, mill records, changes in design, new modern styles, etc., should always be easy of access to the supply department. Records of the distribution of power, changes in location, new rules on switching and terminal work of all kinds, should always be given to the store department. Stated reports, preferably quarterly, should be furnished by all master mechanics, showing just what engines or coaches will be shopped in the following sixty days, and then, with the tire-wear figures, journal-wear figures, etc., it is easy to decide on material needed. A close check should be kept by the store people on all engines and cars, according to the classes and length of time at certain locations. The consumption of cylinders, castings, timber, etc., at these given points in a given time, say two years, would give figures that would be accurate enough to work by. With all this work up and a monthly check of all engines, according to class, that are repaired at each point, it should be no trouble to keep plenty of material on hand, and still keep the stock at an extremely low figure.

A model material platform is shown on page 908. It will be noted that this material is what is known as "finished;" that is, the castings have been machined to size and are in almost every case ready to be applied to the engine on the erecting floor, thus saving delay of the engine in shop by awaiting the re-machining of the old part. This particular platform is storing material ready for shipment out on the road to smaller shops, but such finished material as is needed in the main shop is also drawn from this platform and transported by means of the shop tramway system, one of whose trucks is also shown.

On ten engines of Class 1 type, for example, located at five points, showing a monthly consumption of two link-lifter bushings, it would be a simple matter to cut up twenty feet of tubing and send six bushings, or three-months supply to each point. If this is not done, the chances are that each shop will order a 10 or 16-foot length, and thus have over 100 feet tied up, whereas one-fifth of the stock would have done the business. This example could be carried out indefinitely, until it numbered up in the hundreds, for every point on the system and for each class of engine. Thus the store, by an accurate and careful system of record keeping, should have correct figures on consumption, and then put it up to the shop people to meet the demands. Let both departments get together and work hand-in-hand. Let the shop know what is expected, supply it with material, and require it to deliver the goods. Let the shop people devise

MODEL RAILROAD-SHOP MATERIAL PLATFORM.

This material is what is known as "finished"; that is, the castings have been machined to size and are in almost every case ready to be applied to the engine on the erecting floor thus saving delay of the engine in shop by awaiting the remachining of the old part. This particular platform is storing material ready for shipment out on the road to smaller shops, but such finished material as is needed in the main shop is also drawn from this platform and transported by means of the shop tramway system, one of whose trucks is also shown.

the ways and means and promulgate the methods; if the store supplies the figures and material they are doing their duty; it is then up to the shop people; where the stuff can be put up the cheapest; there is where it should be done. If pilots can be made at one place cheaper than anywhere else, let that point make the pilots; if piston rods can be got cheaper at the same place, let that point make all the piston rods for the system, and so on through the list. After the cheapest point has been settled upon for each article, should it be found to pay to transfer certain machinery to another point, do not hesitate to transfer it. Logs used to be hauled to the saw mills; now the saw mills are taken to the timber. Men are like machines—if it would pay to transfer them, do not hesitate to do it. Do not keep an 18-K man in a 2-K shop; if you cannot give him an 18-K shop take him to it. Give the best men the best facilities and the result will justify the move in every case.

If you get accurate figures, and have the stock properly handled, use the best methods and labor in each department, and have each department in the hands of a good man, and let his word be a law unto all—then the centralization of work cannot fail to be a true time winner.

THE BOSTON EDISON ELECTRIC ILLUMINATING COMPANY'S TURBINE STATION.
Showing coal-storage arrangements. By courtesy of J. E. Moultrop, Mechanical Engineer.

THE PLANNING AND CONSTRUCTION OF THE POWER PLANT.

By A. E. Dixon.

II. THE LOCATION, AND THE STORAGE AND HANDLING OF FUEL.

We pointed out in connection with Mr. Dixon's general introductory article last month that he wrote from the position of a man very much "on the inside" of all the questions arising in the design, building, and equipment of the power plant. His series will cover every important point on the physical side of the problem, and will offer much of value to all concerned in this department of constructive engineering. The next section, which will appear in October, will take up boilers, grates, stokers and chimneys.—THE EDITORS.

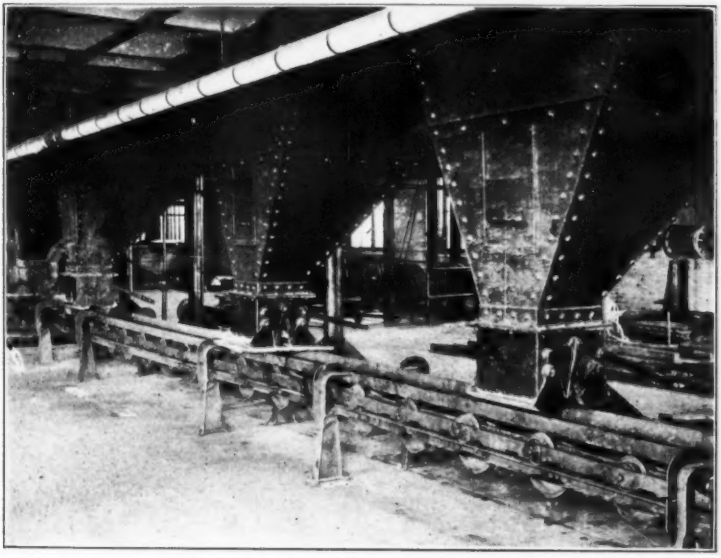
A SUITABLE location for a power plant is often difficult to determine; it often depends upon the source of power to be developed, but there are other considerations. If a water power is used the location depends upon the point where the maximum hydraulic head with a suitable flow of water can be obtained at the lowest first cost, within the practicable radius of distribution. If gas or steam-driven prime movers are to be installed there is more liberty in the selection of a site, but it must be accessible, in regard to the fuel, water, and labor supply and the disposal of waste, etc.

The available local labor supply and the possibilities it offers in the line of skilled men, or the attractions which the neighborhood presents tending to make men contented with the locality, combined with the easy accessibility of the plant from residence districts suited to the various grades of employees, should all be considered. It is comparatively easy to bring men into any locality, but it will often take more than a steady job to hold them, except at times when business

is so dull that it is next to impossible to secure situations in a more desirable neighborhood. Another point to be considered is that after men with families have located in the vicinity of an industry by which they are steadily employed, they are loath to change; and suburban locations, slightly out of the large centers of population, are desirable owing to the fact that labor troubles are not so liable to occur, and should they arise they can be handled better when located outside the lime light. This is particularly the case when considerable space is available around the industry on which temporary shelters can be erected. A desirable location where a permanent force of operatives can be had is an invisible asset of some value.

As to the water supply, considerable latitude is allowable, owing to the possibility of piping water from a distance. Good, pure water in sufficient quantities to cover all possible demands, is required, and the supply must not be subject to interruptions. Where city water is available, it is a good plan to make a connection for emergency purposes; but as such water must be purchased, it is in many cases, desirable for the plant to develop its own water supply. Where water is piped from a distance, it is advisable to provide storage tanks or a reservoir close to the plant, in order to guard against breaks in the line or the occasional unavoidable cutting off of the supply while repairs are being made, or for other purposes. The quantity of water required depends upon several considerations; the amount of boiler feed water depending upon whether surface or jet condensers are used, and in the former case whether the water of condensation is used or wasted; for circulating water for condensers, nearly any kind can be used with barometric condensers, but with surface condensers a strainer is important, and provision for cleaning it, salt or raw river water being used for this purpose. When the water supply is insufficient for circulating purposes, or the cost of water makes it advisable, a water-cooling plant can be installed, reducing the requirements for this purpose to an amount sufficient to make up the loss by evaporation. This plant can be placed on the roof of the building, if no other location is available, in which case the water will be pumped up from the sump and permitted to flow down through the cooler and tank and thence through the condenser by gravity. In many portions of the country, particularly in the limestone regions and around the American Great Lakes, it is almost impossible to obtain good water from natural sources for boiler feeding, and the boilers require constant attention and have to be blown off frequently and likewise shut down to have the scale chipped out. The modern method, and the most economical

plan, of dealing with feed water of this character is to remove the scale-forming substances before they reach the boiler; and while numerous plants for purifying feed water have been installed throughout the middle western States, and have proven their efficiency in actual operation, reducing fuel consumption and the expense of boiler cleaning and repairs, it is nevertheless remarkable that comparatively few of these plants are operated by concerns generating electric power.



A SYSTEM PROVIDING FOR MECHANICAL HANDLING OF BOTH COAL AND ASHES. PRATT STREET STATION, UNITED ELECTRIC RAILWAYS, BALTIMORE.

The ash hopper and cut-off valves above the bucket conveyor show plainly in the picture. The coal in this plant is hoisted by a steeple tower and carried to storage bins on an automatic railway. The C. W. Hunt Co.

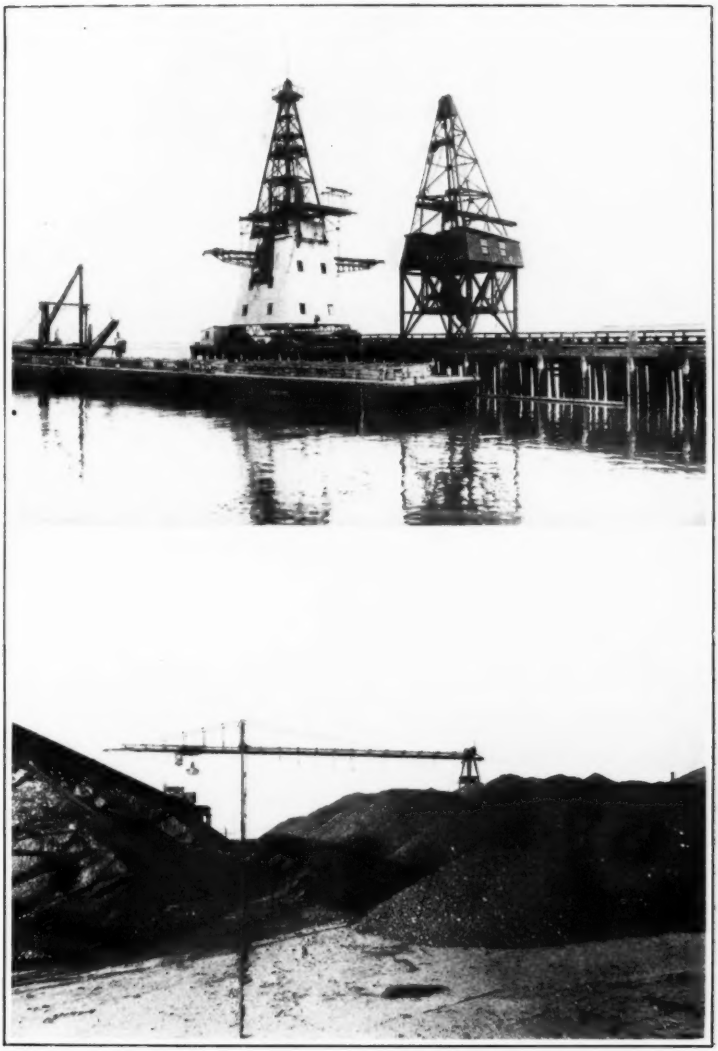
The fuel question—or more exactly, the method by which fuel can be delivered—is of the highest importance. The cost of fuel is not the price entered on the bill, but properly includes all the expense of handling it between the cars and the fire-box, plus the expense of removing and disposing of a proportionate amount of ashes. As the amount of coal required is from ten to twenty times the weight of the ashes, it can be seen that it would be cheaper to cart ashes than it would be to cart the coal; in other words, it is more important to be close to the railroad or water way, so that coal can reach the plant in cars or barges, than it is to be close to the dump where the ashes can be disposed of. In any event, the cartage of either ashes or coal should

be avoided, and the less handling there is between the mine and the ash pile the cheaper the fuel. The importance of looking out for this matter has often been neglected—particularly in some plants which, originally small, have been extended from time to time, until the troubles incident on carting the coal supply (as well as the expense) have forced the construction of a new plant in a more convenient location, and handicapped the concern with a dead investment in brick and mortar.

GENERAL VIEW OF THE NEW YORK EDISON COMPANY'S COAL-STORAGE PLANT, SHADYSIDE, N. J.

Shows part of the anthracite storage, the hoisting tower for anthracite, and the bridge tramway for bituminous coal. Dodge Coal Storage Co., Phila., Pa.

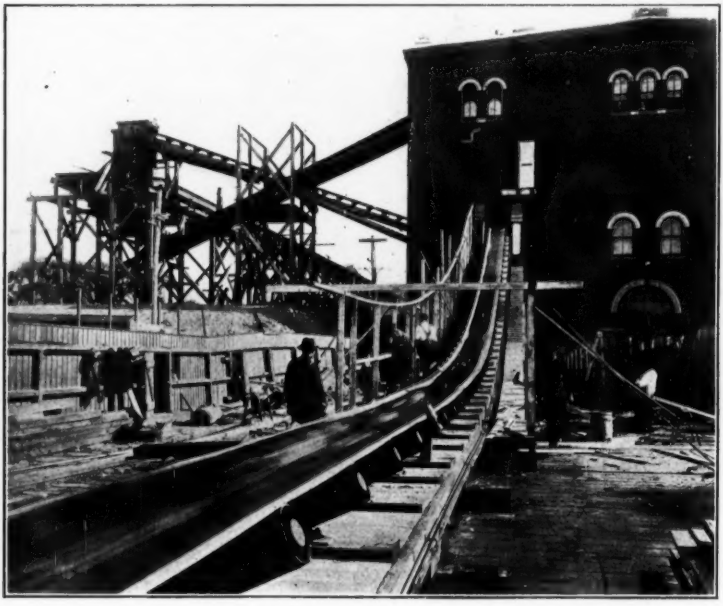
As plants increase in size, the importance of a reserve supply of coal as an insurance against interruptions in the service makes itself evident; small plants often run several days on a car of coal, but there are plants where this quantity would not suffice for one hour. Water transportation is, in many localities, closed for several months in the year, and where it remains open is greatly hindered by floe ice, and it may take several days or a week to place a barge, which under ordinary conditions could be delivered in half a day. The moral of this is, in selecting a waterway choose one where the ice will be swept out by natural currents. Railroads are subject to interruptions from wrecks, storms, and floods, and on several occasions, in the United States during the last few years, have been so badly clogged up with freight that it has been impossible to tell how long a car or train would be on the road. In fact, in some localities an embargo was placed on all except perishable freight, and even the largest industries had trouble in getting fuel enough to keep them going, even when men were sent out to trace cars in. Strikes in the coal regions are liable



COAL HANDLING AND STORAGE AT THE BOSTON EDISON ELECTRIC ILLUMINATING COMPANY'S TURBINE STATION.

The hydraulic tower is designed and installed by the Robins Conveying Belt Co. The bridge, grab bucket and transporter in the lower view are by the Brown Hoisting Machinery Co. The pictures are shown by courtesy of J. E. Moultrop, Mechanical Engineer.

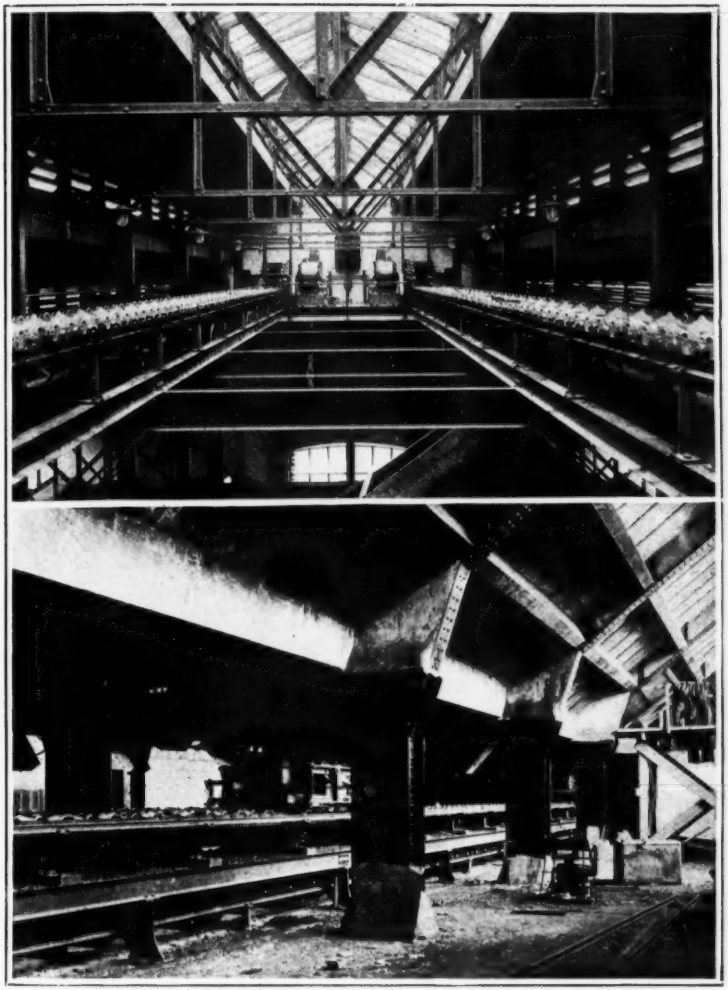
to occur at almost any time (agreements to the contrary notwithstanding) during which production may be stopped for an indefinite period; during and immediately preceding a strike, it is the practice of the railroads to seize all the coal they dare, which is on their tracks, for their own use; and while such coal is ultimately paid for, coal at such a time is the most precious jewel of the power plant. In certain portions of the United States natural gas is available, and can be used under the boilers or in gas engines; of such fuel a reserve is not kept, though often duplicate pipe lines are installed between the wells and



THE COAL CONVEYOR, BOSTON EDISON ELECTRIC COMPANY'S TURBINE STATION.
Robins Belt Conveying Co. By courtesy of J. E. Moultrop, Mechanical Engineer.

the power house. In other localities, oil fuel can be used with advantage, being delivered to the plant by cars, boats, or pipe lines; a storage tank for the current supply is provided close to the plant, the amount of tankage provided being dependent upon the quantity of oil received as a shipment and the fuel consumption of the plant; the regularity of the shipments must also be considered.

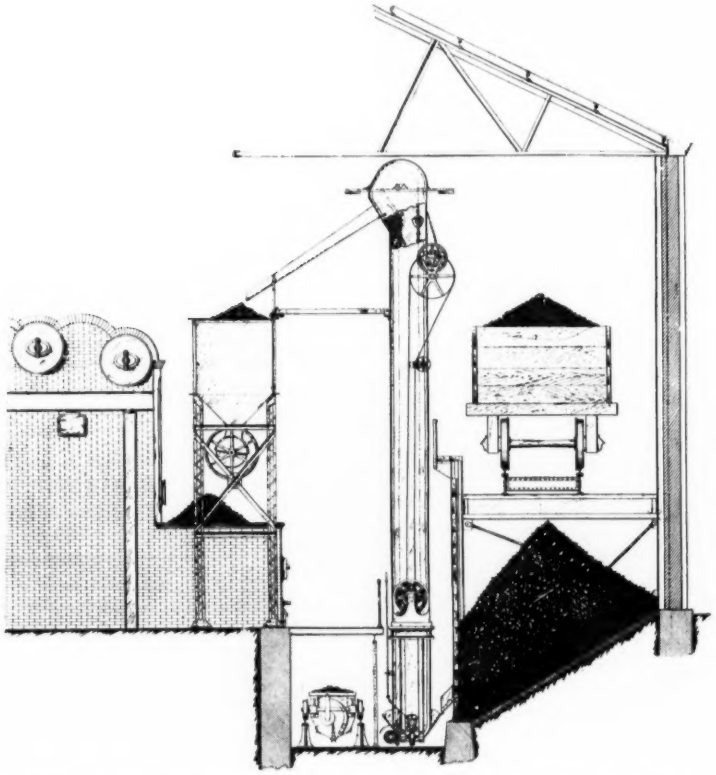
The fuel-storage plant should be, preferably, located by the side of the generating station in order that the amount of plant required will be reduced to a minimum. It is also desirable to provide some



COAL-HANDLING CONVEYORS AT THE NEW POWER STATION OF THE LONDON COUNTY COUNCIL, GREENWICH.

Two combined conveying and elevating strands, buckets pivot-hung on double-strand chain. They receive coal from overhead storage hoppers, outside, through fillers shown in the lower picture; entering the building by a horizontal run of 100 feet, they rise 90 feet to the driving gear seen at the back of the upper view. This consists of two 25-horse-power motors, direct coupled to end shafts of conveyors by cut steel gearing. Thence the strands run horizontally 300 feet, delivering coal to boiler hoppers as seen in the top view. Then dropping to the basement they pass by below the boilers, receiving ashes and dumping them direct to barges outside. This lower strand may be seen in the bottom picture. New Conveyor Co., Ltd., Smethwick.

bunker or hopper capacity over the boilers, in order to guard against conveyor breakdowns.



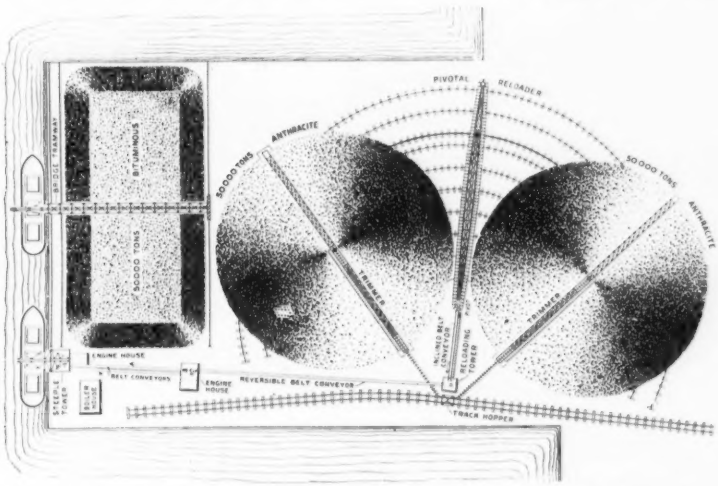
GENERAL PLAN OF COAL HANDLING AT THE UNITED TRACTION COMPANY'S POWER HOUSE, ALLEGHENY, PA.

Heyl & Patterson, Pittsburg, Pa.

A fuel-storage plant of any size involves a considerable investment in its equipment, and to this must be added the amount of capital locked up in the coal stored; the interest on this amount, together with the cost of operation and upkeep add to the fuel expense of the plant. To offset this, it is impossible, except in rare cases, to control the fuel supply from the mines and the services of the transportation medium; therefore it is necessary for the large consumer whose continuity of operation is entirely dependent upon the daily delivery of several hundreds of tons of coal to adopt measures which will efficiently pro-

tect his interests during all emergencies. This can be done only by providing a storage plant of sufficient capacity. A ton of coal at the plant is worth several under contract, for while the contract may provide all sorts of penalties in the line of liquidated damages from failure to deliver, the collection of these sums is slight salve for the black eye given the power plant by reason of an enforced shut down from lack of fuel.

As an instance of provisions of this nature, it may be stated there are several industries in the United States which carry a coal supply under their own control of from 50,000 to 250,000 tons, to guard against fuel shortage. For several years the Carnegie Steel Company had a coke pile at the Edgar Thomson Works, which was 2,000 feet in length and 60 feet high. This pile was started at a time when labor trouble in the coke region was imminent, and the pile was left for sev-



GENERAL PLAN OF COAL STORAGE AT THE PLANT OF THE NEW YORK EDISON CO., SHADYSIDE, N. J.

Installed by the Dodge Coal Storage Co., Phila., Pa. Provides for a reserve supply of 100,000 tons anthracite and 50,000 tons bituminous.

eral years as an object lesson. The pile was ultimately removed, when owing to a locomotive famine, it was impossible to get coke shipments through, and as a result the Carnegie furnaces were kept in full blast when many of the competitors had to bank or shut down their furnaces.

Coal is best stored under cover, but either under cover or in the open—in fact, from the time it is first exposed in the breast at the

mine—all coals, bituminous and semi-bituminous in particular, are losing in heating value, a constant chemical change being in progress by which gas is being liberated. In warm weather or in hot climates this deterioration is more rapid than at low temperatures. These gases are frequently several times the volume of the coal, being occluded or condensed within the solid substance, until by diffusion they escape and are lost in the air. This subject has been investigated by Dr. Lyon Playfair, in England, and Dr. E. von Meyer, in Germany, and the following figures are extracted from a report by the latter, showing the quantity and composition of the occluded gases in freshly mined samples of coal submitted to him. The method adopted to determine the amount of the gases was to place 100 grammes of the coal in hot de-aerated water, which was then boiled as long as any gas continued to be given off, the gas being collected and then analyzed by Bunsen's method.

Sample	Percentage by Volume.				Cubic centimetres of gas given off from 100 grammes of coal
	CO_2	CH_4	O	N	
1	16.51	trace	5.65	77.84	24.4
2	0.34	85.80	trace	13.86	91.2
3	1.15	84.04	0.19	14.62	238.0
4	0.23	89.61	0.55	9.61	211 2

All the above were English bituminous coal, the first being a Newcastle coal and the others from different seams in the same colliery in Durham. The second and third samples, while from different mines, were from the same seam. The depth below the surface from which these coals were raised was as follows: No. 1, 180 feet; No. 2, 445 feet; No. 3, 650 feet; No. 4, 890 feet. It will be noted that CH_4, or marsh gas, formed an important portion of the volume of gases given off by the latter three samples. This gas has a high thermal value. The same losses affect anthracite coal, but only to a slight degree. Oxidation or slow burning of the coal also occurs, and it not only loses in weight but in heating values. In one instance the decrease in weight observed in some stored coal was over 35 per cent, after a lapse of some years.

For the generation of steam power, bituminous or semi-bituminous coals are widely used; the smaller sizes of anthracites are also burnt in many plants, but for these latter coals a high chimney or forced draft is required.

All coal contains some moisture, and when exposed to the weather it increases its moisture content. The bituminous coals seem to undergo a slacking process, the size of the lumps being reduced and

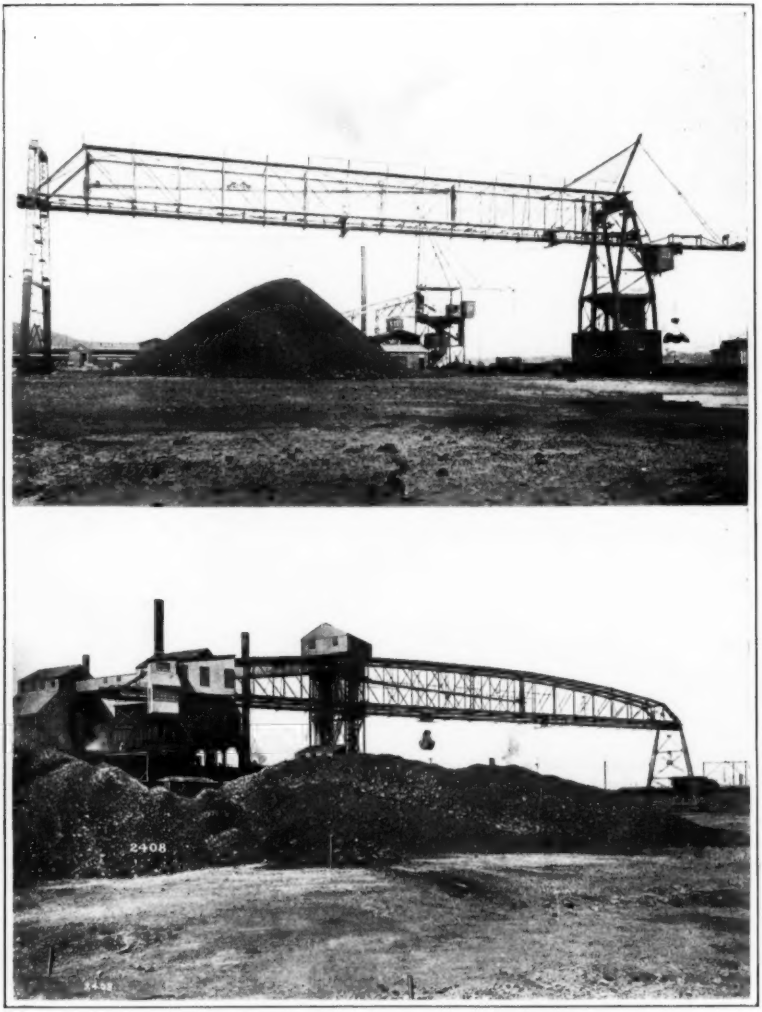
FLYING BRIDGE, AMERICAN TUBE & STAMPING COMPANY'S BILLET MILL, BRIDGEPORT, CONN.

Robins Conveying Belt Co.

the percentage of dust being greatly increased. In winter the contained water freezes and breaks up the lump coal.

Coal is usually shipped from the mines in hopper-bottom or high-sided gondola cars, which are open to the weather; as a result, in winter, shipments often arrive frozen solid in the car. Such coal is rather difficult to handle; explosives cannot be used in wooden cars, and unless considerable care is employed will damage steel cars; this makes it necessary to thaw out the coal. For this purpose steam lines should be run along the tracks on which the cars are handled, provided with steam-hose outlets at car-length intervals. Steel hopper cars are thawed by inserting the nozzle through the hopper in the bottom, the coal as released falling into the track hopper, but for gondolas this operation is troublesome. The steam pipe, along the track, should be very well protected from the frost, owing to the fact that condensed steam which accumulates in it in the intervals of disuse freezes very easily.

Outdoor stock piles, during cold weather, accumulate a frozen crust which is often so thick that grab buckets cannot penetrate it. Explosives furnish the easiest method of dealing with this difficulty, but it will be found usually that considerable labor will be required to break up the large pieces to sizes that can be handled by the conveyors and crushers. To deal with such pieces, and also to warm up the conveyors and bearings previous to operation, steam-hose outlets along the runways and at the machines can be provided. A judicious use of a little steam on the conveyor bearings, after a cold snap, will make the machinery a great deal easier to start.



TYPICAL EXAMPLES OF LARGE COAL-STORAGE INSTALLATIONS.

The lower one is at the Sparrow's Point plant of the Maryland Steel Co., commanding a storage of 50,000 tons bituminous by a 280-foot span steam-operated bridge tramway. The upper one is at the Shadyside plant of the New York Edison Co., steam-operated over a 200-foot span, with a 2-ton clamshell bucket, giving a storage of 50,000 tons run-of-mine bituminous. Dodge Coal Storage Co., Phila., Pa.

Another trouble with stored coal is its heating and igniting spontaneously. Any bituminous coal of a friable nature, and particularly those containing "brasses" or iron pyrites (FeS_2), are liable to this trouble; when the coal is stored in a damp condition the trouble is aggravated. The cause of such fires is obscure, but they probably arise from the absorption of oxygen by the carbonaceous matter of the coal, in the same manner as oily cotton waste ignites from the same cause. In many plants the bunker construction is well designed to contribute to the starting of such fires, the entire boiler room being covered and no outlets being provided along side of the bunker to permit the hot air arising from the boilers to escape.

These fires start at or about the bottom of the pile and may burn undiscovered for a considerable time. The indications of such a fire are a sensible rise in the temperature of the stored coal, a sickly odor, and a choking or smothering sensation in drawing breath when on that portion of the pile. Water is almost useless in fighting a fire of this kind, as the heat partially cokes the surrounding coal, forming a roof which prevents water reaching the fire in sufficient quantity to do any good, or the water will be turned into steam before reaching the fire. Sometimes it is possible to drive pipes, with pointed ends in which a number of holes have been drilled, through the coal to the seat of the fire, and by this means water or steam can be used with advantage; but to be absolutely sure it is necessary to move the coal and uncover the seat of the trouble. In bunkers this is a very necessary precaution, as the pasty coke formed by the fire will stick to the concrete or steel and furnish a dead spot as a nucleus for another fire.

There is considerable conflict of opinion in regard to the best method of preventing such fires, ventilation being recommended; should this method be adopted the ventilation should be thorough, for sluggish ventilation will not reduce the temperature of the pile, but on the contrary may tend to increase the trouble greatly. Fires of this kind are very common, but are usually discovered before they have made much progress. In large exposed piles there is less chance of their being caught at an early stage, and only a few years ago a fire of this kind burned for several months in a large pile, being finally discovered, because on this portion of the pile the snow melted as fast as it fell, while the remainder was deeply covered. This fire was a costly one, as several thousand tons of coal were consumed and considerable expense was incurred in extinguishing it.

The general arrangement and the plant required for coal storage depend largely upon local conditions. Most of the firms building this

COAL UNLOADING TOWER AT THE INTERBOROUGH RAPID TRANSIT COMPANY'S 59TH ST. POWER HOUSE, N. Y.

Installed 1906 by Mead-Morrison Mfg. Co., N. Y.

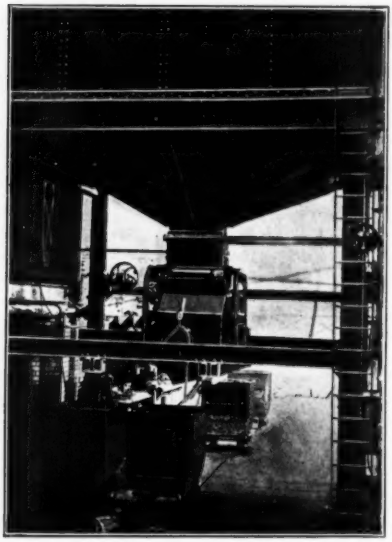
class of machinery are prepared to submit designs for plants of any desired storage and handling capacity, when they are furnished with ground plans of the area to be covered, and its contour. Some machines require level ground or else expensive grading to level up the area. Other machines require a runway track to be levelled up, the portion of the ground to be covered with coal being left in its natural condition, provided it is sufficiently firm for the purpose, or if the bridge be equipped with a suitable bucket, it can be utilized to do all of the grading necessary.

The character of the plant will depend, in part, upon the method by which the coal is received and sent out. In some cases coal is received only by boats, in others by cars alone, while in some plants it is desirable to arrange to receive or ship by both methods. As a general proposition, a traveling bridge supplied with a conveyor for stocking the coal and a bucket for getting it out, will be the most feasible method for large piles, for the reason that indefinite longitudinal expansion can occur; such expansion is not possible with circular piles. A bridge also has the advantage of being able to reach any part of the pile at any time; this may be very valuable should a fire occur. Bituminous coal should not be piled higher than thirty feet, and preferably lower.

When the plant is close to the power house conveyors can be used for transferring the coal to the bunkers, and this is the usual arrangement; but where real estate is expensive, it may be desirable to locate the storage plant at a distance from the power plant, and ship the coal in as desired by cars or in barges, as is done by the New York Edison Company. This latter is, however, a forced arrangement to suit exceptional local conditions, and has too many disadvantages to be even considered, except in a parallel case.

BOILER HOUSE OF THE SCOTTISH CO-OPERATIVE WHOLESALE SOCIETY, GOVAN.

The elevator carries coal over the main railway line, 30 tons per hour, 90 ft. per minute, and discharges into a conveyor. It has 14-inch roller buckets. Blake, Barclay & Co., Greenock.



A PLANT FOR STORING COAL AND WEIGHING IT TO THE BOILERS.
Graham, Morton & Co. Ltd., (Maurice Graham), Leeds.

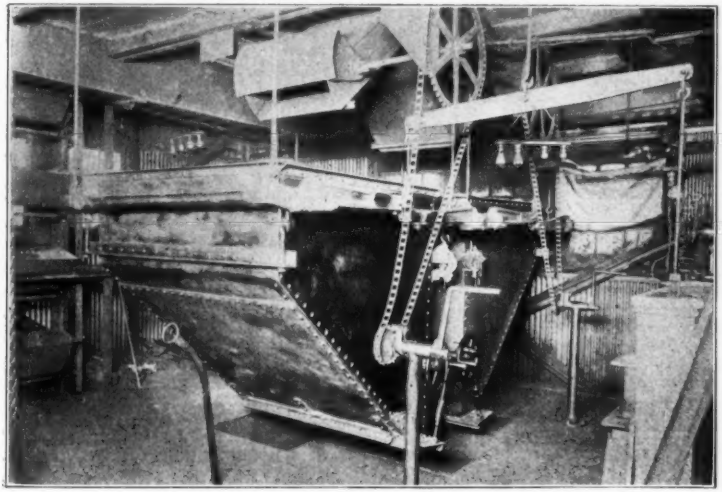
The coal-handling arrangement at the power house depends upon many considerations, being effected by the arrangement of the boiler plant and the location of the chimneys. In plants of any size mechanical stokers are generally employed to reduce the fire-room force, and it is desirable, even with hand firing, to chute coal down from overhead in preference to having it shoveled into cars or wheel-barrows, brought in by laborers, and either dumped in front of the boiler or shoveled from the car on to the grate. This latter practice is a favorite one at small hand-fired plants, the car or barrow often being run over a scale on its way to the boiler, and the weight of the coal and the boiler it is destined for being recorded. In plants having the boilers arranged in two rows with a common firing aisle, in some cases as many as three decks being used, the coal is of necessity brought down from above. The bunker capacity provided is determined by the location of the plant, but usually sufficient storage is provided to run from one to two weeks. This heavy bunker over the boilers of necessity makes the steel frame of the building very expensive, and is undesirable if any other method of storing the coal can be provided. If outside stock piles can be used, it is necessary to provide only sufficient storage capacity, over the boiler, to tide over conveyor break downs, and to act as a reservoir from which the stoker hoppers can be filled.

In some few boiler-houses weighing machines have been installed, by which the amount of coal consumed by each boiler can be determined. In other cases an attempt is made to keep track of the amount of coal burned by using the chute as a measuring hopper, the weight of coal which it will contain being determined by experiment; this method, however, is somewhat crude and uncertain. It is hardly necessary to say that some record of each boiler's performance is desirable

—in fact, is absolutely necessary for intelligent management, and such data cannot be secured unless the coal and ashes of each boiler are weighed with commercial accuracy. The day of guess-work boiler management in the power plant departed a number of years ago in some lines of work, and it is going fast everywhere.

The chutes or spouts by which the coal passes down from the bunkers should be designed to avoid blocking up. Coal, like sand, has a tendency to form arches between the walls of the pipe, which have to be poked out from time to time. Round pipes are worse in this respect than square ones, and the larger the pipe the less chance of its blocking; but there are limits to the size, therefore "Y" outlets should be provided at each floor in the pipes which pass through it, to permit poking out the pipe when the necessity arises.

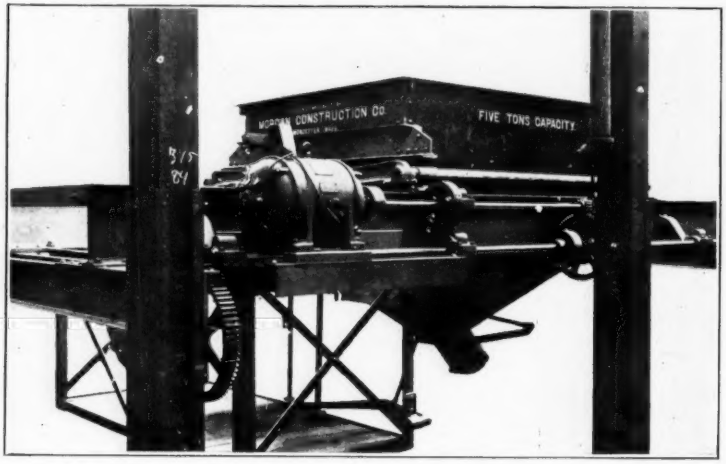
The amount of overhead bunker capacity varies with the layout of the boiler house; in some cases the stacks are at the sides of the building and the bunker is continuous the full length of the building, but when the stacks are mounted on platforms over the firing aisles the bunker capacity is reduced by the amount of space taken up in this manner, and it is also necessary to install two distributing conveyors in order to trim the bunkers automatically; in fact, unless the bunker is very narrow or the surcharged height of the coal pile above it



DOUBLE WEIGHING HOPPERS FOR COAL, POWER PLANT OF THE INTERBOROUGH RAPID TRANSIT CO., 74TH ST., N. Y.

The coal is fed to McCaslin conveyors. Installed by John A. Mead Mfg. Co., N. Y.

greatly exceeds that permissible in regular practice, two conveyors, one on each side of the center and about one-sixth of the width of the bunker from it, will reduce considerably the amount of hand trimming required. It is impossible to avoid hand trimming entirely, and occasions will arise on which men will have to be sent into the bunkers —to uncover a fire, for instance; to provide for this contingency permanent ladders reaching to the bottom of the bunkers should be built into its lining, at convenient intervals.



CRANE TYPE TRAVELING COAL ELEVATORS, UNION STEEL COMPANY'S BOILER HOUSE.

Installed in connection with Sterling boilers and chain grate stokers by Heyl & Patterson, Pittsburg, Pa.

In long buildings it is desirable to reduce the length of the bunker distributing conveyors; this can be done by locating the elevators near the center of the plant, or when local conditions forbid such an arrangement, by sectionalizing the longitudinal conveyor. With this latter arrangement the capacities of the different sections can be proportioned to the amount of coal they are required to handle. In the Long Island City plant of the Pennsylvania, New York and Long Island Railroad, there is no conveyor, a cable railway being used to distribute the coal; while in the Cedar Avenue power house of the Cleveland Electric Railway, coal cars of 50-tons capacity are elevated to a track running over the bunker; these cars when loaded have a gross weight of approximately 140,000 pounds, necessitating very substantial construction of the apparatus and building. In this latter case the unloaded cars can be lowered to the basement and run in under the boilers to receive ashes from the hoppers built for this purpose. The plan is shown on page 933.

ELECTRIC CHARGING CRANE WITH WEIGHING HOPPER.
Morgan Construction Co., Worcester, Mass.

The conveyor layout should be kept in mind from the beginning, as it is necessary to allow room for the conveyor runs and for the walkways which parallel them. The conveyor runs should be as

short and direct as possible and corners or turns should be avoided. As far as possible, horizontal and vertical runs should be used; inclined runs are undesirable with bucket or scraper conveyors, and except for slopes of less than 22½ degrees are impracticable for belt. Scraper conveyors waste a great deal of power, owing to the friction of the coal against the bottom of the trough. Bucket conveyors are more economical of power on the horizontal runs, and are the only type which is available for vertical lifts. Belt conveyors are the most economical, in regard to power, for horizontal and slightly inclined runs. In a few cases belts have been used to elevate material to considerable heights, a series of inclined conveyors being used when the height was too great to be reached by one belt on a straight run.

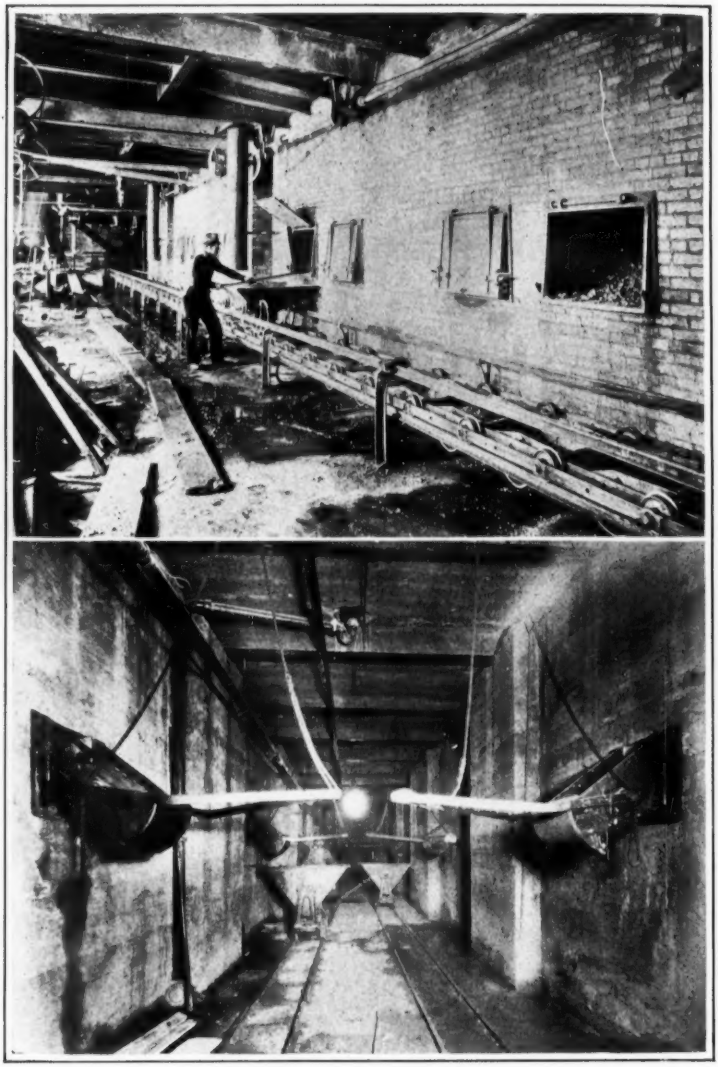
A COAL HANDLING CONVEYOR IN A TUNNEL, WITH DOUBLE-FLAP FEEDING VALVES.

The lower flap is operated by a hand lever and the flow of coal regulated by adjusting the length of the chain. The C. W. Hunt Co., N. Y.

One serious fault with bucket conveyors, in particular, and all link conveyors in general, is the high fibre stresses to which the pins are subjected. This machinery is rarely operated with skilled supervision, and in spite of the best designed automatic oiling devices and dust guards, continual care is necessary in order to guard against the pins

PART OF THE COAL-HANDLING INSTALLATION AT THE SUBWAY POWER PLANT, 59TH STREET, NEW YORK.

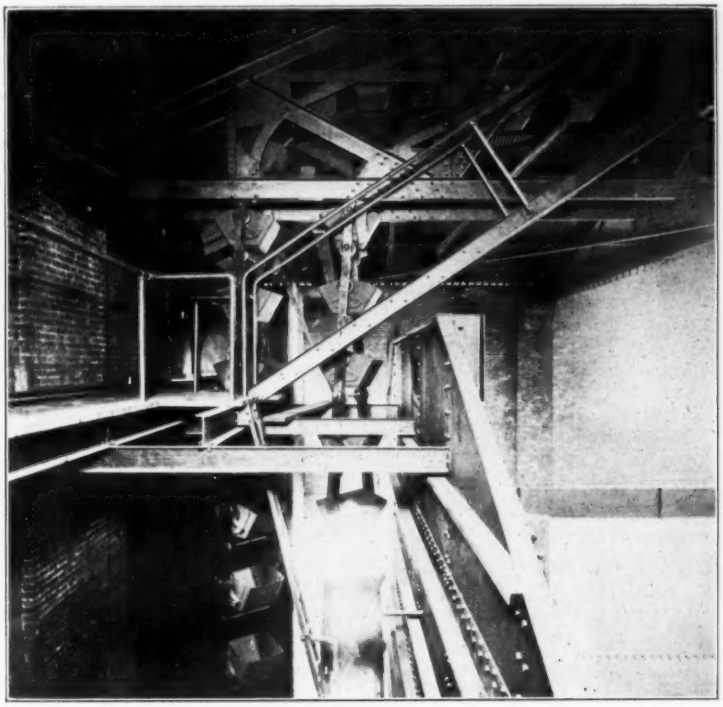
The upper picture shows the inclined conveyor, the lower one the distributing conveyor. Robins Conveying Belt Co., N. Y.



TWO METHODS OF HANDLING ASHES BY MECHANICAL TRANSPORT.

In the lower one the ashes are drawn through valves into ash cars running on a track; this is at the plant of the Maryland Telephone Co., Balto., Md., and was installed by the Mead-Morrison Mfg. Co. In the upper view the ashes are seen falling into the lower run of a McCaslin conveyor, the installation being by John A. Mead Mfg. Co., N. Y.

being cut to a dangerous degree in a very short time. Vertical conveyors should be provided with a safety clutch to prevent the loaded leg piling up in the bottom of the shaft should an accidental failure of the driving mechanism occur. In high lifts, where the strain is greatest, I am in favor of arranging latches at intervals which will hold the conveyor should the chain part.



A VERTICAL LINE OF CONVEYOR BUCKETS WITH A TWIST IN THE CHAIN TO CHANGE THE DIRECTION.

The C. W. Hunt Co., N. Y.

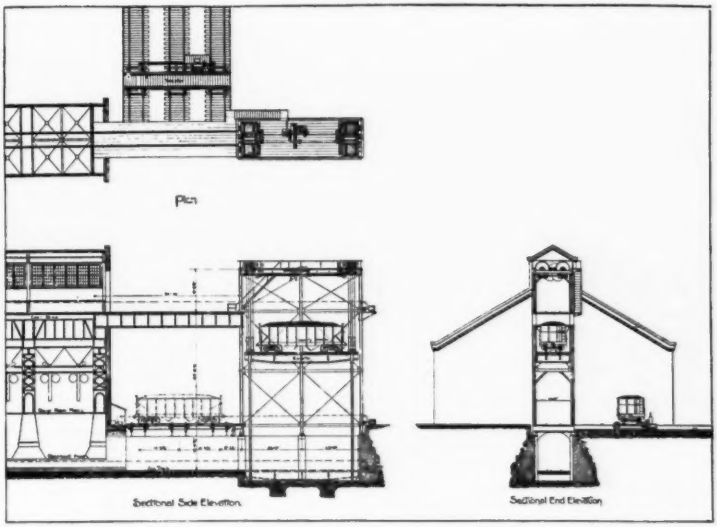
In the eastern States "run-of-mine" coal is commonly used, which requires crushing before it is suitably sized for use on mechanical stokers. This necessitates the installation of the crusher close to the unloading machinery. The design of the crusher should be substantial, and whether toothed or grooved rolls are used depends upon the size to which the coal is to be crushed. One element of the crusher is a so-called "breaker"—a cast-iron block designed to break before other portions of the machine have been damaged by any obstruction

DOUBLE-STRAND ROLLER TYPE CONVEYOR SUPPLYING THE BUNKERS OF A BOILER PLANT.

Capacity 30 tons per hour; 140 feet long, 15 inches wide. By Blake, Barclay & Co.

or hard piece of material. The crusher builder could, with advantage, take a lesson from rolling-mill construction, where in the dark ages breakers were considered to be absolutely necessary, but years ago designers commenced to make the breakers solid and design the mill heavy enough to stall the engine, which is the rational method of treating such classes of machinery. That is, the driving motor should be heavy enough to do its work, but not heavy enough to twist the machine to pieces; this does not mean a reduction in the size of the motor, but an increase in the strength of the other parts of the machine, whose weights have been reduced to the lowest possible limit in order to save cast iron and fill the demand of the concern looking for the lowest bidder instead of the best machine.

Comparatively few plants in the eastern United States are located on railroads, in localities where tide-water frontage can be secured, owing to the fact that coal in cargo lots at the wharf is cheaper than railroad coal delivered on a siding along side of the plant. Clam-shell grab buckets are usually employed for unloading. The hoists are speeded to make between one and two trips per minute, and are operated by either steam or electric power, to suit the demands of the purchaser. The buckets generally have a nominal capacity of one ton,



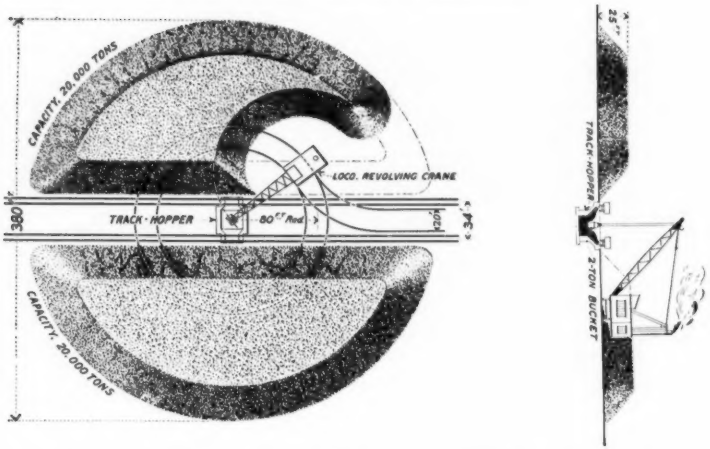
TRANSFER AND ELEVATOR FOR COAL AND ASH CARS, CEDAR AVENUE POWER HOUSE, CLEVELAND ELECTRIC RAILWAY.

Loaded coal cars are raised from railway siding to storage bins over the tops of the boilers, and empty cars are lowered to a basement track running under the ash hoppers beneath the boilers. The transfer table is designed to handle loaded cars weighing 140,000 lb. The elevator works by four hoisting drums geared to work in unison and driven by electric motor. The Wellman-Seaver-Morgan Co., Cleveland, Ohio.

and an actual capacity about 20 per cent less. In a few cases larger buckets are used for coal, while for other materials buckets up to 15-tons capacity are used. In the older hoists chain was employed, but it is uncertain, liable to sudden failures which cannot be well guarded against owing to the fact that chains do not give any premonitory warnings of the approaching failure. Wire rope, on the contrary, gives ample warning of its approaching failure by the breaking of the surface wires, so that there is no excuse for dropping the bucket through the bottom of the barge and blocking up the coal wharf.

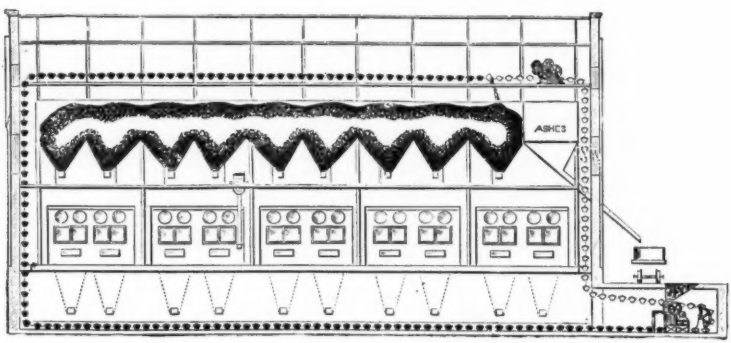
The coal from the bucket is received in a hopper from which it passes to weighing hoppers, and from them into the chute leading to the crusher. In order to prevent the clogging up of the crusher by passing all of the fine coal through it, this chute can be provided with a screen bottom permitting the fine coal to by-pass the crusher and reach the elevator.

The coal-hoisting tower for boat coal is, with a few exceptions, neglected from an architectural point of view. In most cases it has the appearance of being forgotten and left out in the cold. The stand-



DODGE COAL-STORAGE SYSTEM FOR 40,000 TONS BITUMINOUS COAL SHARON COKE CO., SHARON, PA.

ard finish is corrugated iron—generally galvanized, which does not harmonize well with the main structure. A traveling tower would be rather troublesome to an architect, but it as well as the stationary tower will yield to suitable treatment. Reinforced concrete can be used for sheathing, instead of the more usual materials, and the possibilities in this line are enormous. An example of the rational treatment of the coaling plant to harmonize with the main building is presented in the two recent plants of the New York Central Railroad.



GENERAL ARRANGEMENT OF COAL AND ASHES-HANDLING PLANT, SHEPHERD'S BUSH STATION, LONDON.

Installed by the C. W. Hunt Co.

EDITORIAL COMMENT

IN directing the great sources of power in Nature to the use and convenience of man the engineer has an increasingly difficult task. Not only has he to manufacture power, and apply it to the industrial arts, but he has also to meet the antagonistic forces of Nature and either oppose them successfully, or so divert them as to render them harmless, if not directly useful. In this manner he has made large progress in controlling the winds of the air and the waves of the sea, and now he has before him the task of meeting the waves and tremors of the earth.

Following close upon the disaster at San Francisco comes the report of earthquake and consequent fire at Valparaiso, the great Pacific seaport of South America, and although details of the extent of the disaster are lacking at this writing, it is evident that much damage has been done, not only in the important Chilean seaport, but also in the cities and towns back from the seacoast, in the mountains.

Such convulsions of Nature, with their attendant destructive effects to buildings, water supply, railroads, and other structures, must be met in some way by the engineer, or, failing such control or management, notice must be served upon the inhabitants that they occupy the land at their own risk, and to such great disadvantage as to constitute a permanent handicap to real progress. This latter condition is one which cannot be conceded until the best efforts of engineering skill have been exhausted, and in the present condition of affairs it must be admitted that the earthquake problem has scarcely been attacked at all by the engineer.

The earth tremors which have occurred on the Pacific slope, both in North and South America, appear, in the opinion of the ablest geologists, to be due to subterranean land slips, occurring along the lines of geological faults, and to be altogether free from volcanic origin. This being the case, it rests with the geologist to select the foundation, and with the engineer to insist upon the use of structures of sufficient combined strength and elasticity as to oppose earth movements with the least possibility of injury.

It is no new thing for the engineer to design structures which shall retain their integrity against sudden and violent tremors, but he has not, until now, taken this element extensively into account in connection with buildings. The so-called "elastic theory" has been broadly accepted in opposition to the earlier treatment which assumed the rigidity of the material, and it is about time for the designer to remember that elasticity is a very real property of matter, and that combinations of various materials should be so made that this feature of elasticity should be preserved and even augmented, rather than neglected, and that the apparent solidity and rigidity of great masonry structures, buildings, sea walls, dikes, dams and all the productions of what has been termed "statical" engineering, should be replaced by combinations of stiffness, strength and elastic resilience.

The problem is no new one. Every great railroad bridge has to sustain the shock of impact of advancing trains, and does sustain such shocks and vibrations again and again, rarely failing in service and generally outliving the demands to be replaced only because of the requirements of heavier traffic. When the seismograph is applied to a long-span railroad bridge the indications are more extended, in many instances, than the records of a severe earthquake, and yet the structure

withstands such shocks repeatedly, because it has been designed with that end in view.

In like manner the modern transatlantic steamships, exceeding in length more than double the height of the tallest of modern buildings, are exposed almost continuously to shocks and buffetings which would shatter the ordinary building as effectually as any earthquake, and such shocks and vibrations are resisted as a matter of course. Not only is the problem an old one, but its solution is well-known and complete.

It is to the engineer, then, that the architect and builder must turn for instruction in the art of design and construction for earthquake countries, and the engineer in response need evolve no new theories, nor discover no new principles. He may safely apply the methods and materials which he has already tried and proved in locations where vibrations, as severe as any tremors of the earth, are of continual occurrence, and be as assured of the stability and permanence of his work in the one case as in the other.

* * *

The warning uttered in our pages this month by Dr. Louis Bell on the subject of over-specialization is not the first criticism on this tendency that has been made in our pages. As long ago as 1901 the late Mr. Slater Lewis, writing under the title "The Limits of Specialization" in our Works Management Number, called attention to what was at that time not by any means an obvious phase of the question. At that time the so called "American invasion" was in full swing, and the products of American engineering factories were being poured into the British markets in quantities and at prices which seriously threatened the prosperity of many old established firms.

It need hardly be said that this development has fallen far short of its original promise. The threatened mechanical industries of Great Britain are stronger than ever. Indeed, the shock of a suddenly developed and very intense competition served a useful purpose. It led to the abandonment of many methods that were obsolete, and to a study of the whole problem of engineering manufacture from new points of view, distinguishing between practices that were both old and useful and others not only old but also out of date.

But a few—probably very few—observers saw the thing in its true light. They saw that technical evolution was only one side and perhaps a comparatively small side of a complex question. That machine tools *could* be made in enormous numbers precisely like watches was clearly evident, but that they *should* be so made was even then a doubtful proposition.

"Whilst it is true," said Mr. Slater Lewis, "that specialization leads to a gradual transfer of operations from the hands of the engineer to those of the manufacturer, it must not be lost sight of that the manufacturing of engineering articles is somewhat different from any other. These articles are not in themselves prime objects of consumption like silks or condensed milk. . . . Where the technical conditions of the problem favor a uniform product and hence specialization, it does not follow that the latter is commercially possible." This of course is the real crux of the problem. Technically speaking it is possible for specialization of manufacture to be carried to any length imaginable. Commercially speaking we may have to stop short very near our starting point. The demand for any particular product is severely conditioned by a host of causes over which the manufacturer has absolutely no control whatever, and a more hopeless burden than a highly specialized plant of which the product is no longer in demand cannot well be pictured.

REVIEW OF THE ENGINEERING PRESS.
"THE WORLD IS ITS FIELD"

BRITISH EXPORT TRADE.

CONDITIONS INFLUENCING THE EXTENT AND DEVELOPMENT OF THE ENGINEERING EXPORT TRADE OF GREAT BRITAIN.

W. Pollard Digby—Journal of the Society of Arts.

IT is beginning to be generally realised that the engineer is profoundly interested in the economic side of industry, and that the commercial side of life belongs to him almost as much as does the department of production—he must not only know how to make things, but also to sell them. For this reason the paper of Mr. W. Pollard Digby, published in a recent issue of the *Journal of the Society of Arts,* is of value, dealing, as it does with the conditions which govern the disposal of the products of British engineering in all parts of the world.

"Of our present export trade, particularly in engineering articles, much is due to the prior demands of our home industries. Our locomotive export trade is the direct heritage of the internal development which followed the opening of the Liverpool and Manchester Railway. Abroad there arose a desire for railways, and an important export trade arose. Into the economies of external trade it is not necessary to enter here, and speculation may be dismissed as to how far there were or are exports of capital and the manner in which payment was obtained. Pre-eminent in cotton spinning we have equipped the mills of the United States, India, and Japan with machinery, whereby the raw cotton can be worked up nearer to the place of its production. Successful as shipowners of British-made vessels, we became successful as shipbuilders for other countries, it being always remembered that local raw material in the first place rendered it possible to manufacture for our own needs.

"Our trade in machinery, our shipbuilding, and, incidentally, our spinning and weaving industries have been largely aided in their advance by the comparative nearness of our manufacturing centres to the sea. Especially favored in this respect Great Britain has, until recently, been troubled by no misgivings as to her position as the leading manufacturer of machinery and engineering commodities generally in the world. Her output includes iron and steel in forms, cast, rolled, or forged, locomotives, steam engines, pumps, textile and agricultural machinery, electrical goods, and ships of all kinds. In regard to all of these a reputation of first-class work is still the boast of British manufacturers, but a very large proportion of the trade in agricultural, and a large proportion of the demand for electrical machinery in the neutral markets of the world is now met by American and German material. Notwithstanding this competition, regarded externally, British engineering exports are equal in total value to those of Germany and the United States combined, while taken per head of population they are much greater."

According to the statistical figures, quoted by Mr. Digby at length, British export trade in machinery suffered a severe decline after the year 1900, but there has since been a steady recovery, corresponding to declines on the part of Germany and the United States. Some idea of the magnitude of the engineering

exports of Great Britain may be gathered from the figures given by Mr. Digby, of which we give only an abstract in round numbers. Thus, during the past year these exports included steam engines for agricultural purposes in value of one million sterling, while locomotive engines were represented by nearly 2½ million, and other steam engines by as much more. Agricultural machinery was exported to the value of one million pounds, and sewing machines were accountable for two millions. Textile machinery was sent abroad worth more than 5½ million pounds, and other machinery amounted in value to nearly 7½ millions. The value of ships sent abroad reached nearly 5½ millions, while manufactured shapes in iron and steel reached a value of nearly 32 millions.

"Among the many features to which attention should be directed in regard to export trade, the packing of machinery and instruments for export is of supreme importance and merits careful attention. The trader whose engineering commodities have, by their superior design and staying qualities, won for him a considerable foreign trade, must become a student of the climatic conditions of the countries to which his manufactures are transported, of the conditions of transport, and facilities for handling his goods, both at the port of landing and up country. It would naturally be extremely prejudicial to electrical machinery, say, if sent in too heavy a package to a port on the African coast; it became subject to all the disabilities of heavy packages removed from cranes and railways, i. e., much levering over, any side up, with as much care and consideration as the ordinary laborer displays towards a package which he considers has been especially sent to strain his sinews, and therefore deserving of some hallmark of his resentment; in some cases even local repacking in smaller boxes becomes necessary for transportation up country, under awkward conditions as to obtaining suitable boxes, packing, and protecting material. If it is found that facilities for handling exist right up to the works (it is not pleasant in England to have machinery delayed owing to the non-existence of a suitable trolley in the neighborhood) well and good. Another class of mishap has been at this end of the transit, i. e., the breaking through of the wheels of the vehicle carrying heavy machinery into an insufficiently-protected sewer, and it is therefore imperative that the weights of packages should coincide with the buyer's requests. Probably a strong heavy package will be best, but in cases where the machinery must be taken over rough roads and light bridges, necessarily it must be split up into a variety of packages, even at the risk of their not all arriving simultaneously. It will be found conducive to satisfaction on the part of the buyer if such things are studied as enclosing spares of the less expensive small parts, such as bolts and nuts, keys, cotters, and other fittings, the losing or breaking of which is not particularly likely, but would, in the case of an oil engine up country, very possibly mean a cessation of running till such time as a new one can be contrived. The co-operation of the buyer who has become intimately acquainted with the effects of climatic and other drawbacks is, of course, very desirable. The exporter must endeavor to see the matter from the buyer's point of view, and the buyer to indicate to him in what way local circumstances differ from the normal."

Many British exports are sent to tropical countries, and Mr. Digby wisely calls attention to the necessity for protection against moisture. Plating, greasing, or otherwise protecting delicate parts against the action of rust, will be found essential, and the climatic conditions at the time of shipment should be observed as well as those of the country of destination, otherwise much dampness and moisture may be enclosed in the packing cases.

"It should not be very difficult to design a special class of machinery suited to the conditions met with in climates presenting extremes of heat and moisture, and this consideration brings us to a very important feature in the export of machinery, i. e., the necessity for standardising, not only each type and set, but every separate part, so that a cabled code-word will be all that is necessary to insure the dispatch of exactly the right size of field coil, or piston rod, or whatever happens to have succumbed. The gradual elimina-

tion of awkward projections, or castings calculated to set up strains in cooling, and thus liable to break under slight concussion, has now been going on for some time in the leading ironworks of this country, and it should be possible for them each to arrive at their own especial set of sections, not in a spirit of desire merely to differ from competing firms, but in honest endeavor to improve on their design. In the more delicate electrical instruments necessary in high-tension station work, the packing question is especially important."

Mr. Digby refers to the importance of standardisation as the most practical method of overcoming the disabilities of producing in one country articles especially suitable for use in a totally different one. In this respect the work of the standards committee may be productive of much good, as leading the consulting engineer to specify standard products, instead of requiring fresh types.

There is no reason why standardisation should destroy that competition which is one of the recognized incentives to high-class production. The result of its universal adoption would be to cheapen production to an enormous extent, and consequently leave the manufacturer more chance of excelling by the quality and finish of his work, rather than by a claimed higher output or longer life, difficult to justify in the face of continual changes in the machinery of production and in the continued evolution of improved types.

Mr. Digby advocates increased activity on the part of public officials, in the improvement of consular reports and in the Intelligence Department. At the same time it is important that the merchant himself should use the utmost activity in disseminating information concerning the excellence of his wares, and in this respect much may be learned from his German competitors.

IRON-ORE SUPPLIES.

THE FALLACY OF ALARMIST REPORTS AS TO THE EARLY EXHAUSTION OF THE IRON-ORE RESERVES OF THE WORLD.

John Birkinbine—Iron Age.

THERE has been of late discussion concerning the rate at which the iron-ore deposits of the world are being used up, and some alarmist writers have maintained that before very long the demand will outstrip the supply. This is a question which demands temperate and thoughtful discussion, and it is just such a discussion which is given in a paper by Mr. John Birkinbine in a recent issue of the *Iron Age*.

"The prophecies of exhaustion of iron ore depend for their fulfillment on a practical continuance of existing conditions, such as the relative location of iron ore producing mines, iron ore consuming plants, coal deposits and coke ovens, moderate changes in labor conditions; on labor saving or transportation facilities ceasing to improve; on manufacturing and industrial centers being mainly limited to those now recognized; on little if any progress in the metallurgical processes. Moreover, such prophecies omit the possibilities of other metals or alloys being produced at a cost competing with iron at or near present prices.

"Had the ironmaster of half a century ago been informed that in 50 years the production of iron would reach the quantities now annually made, and had he believed this otherwise possible, he would have prophesied that sufficient ore could not be found to produce such an enormous output, and he would have expressed doubt as to the possibility of obtaining fuel to smelt the ores or of assembling these at blast furnaces.

"Are we not in prognosticating a shortage of iron ore viewing the future with comparatively as little knowledge as the ironmaster of 1856? Naturally each contributor to the discussion views the problem from his country's standpoint. But any estimate of mineral reserve must assume that the whole world has been explored for the specific mineral indicated. Railroads and steam vessels are now absent from few of

the geographical or political divisions of the earth, and where other slower or more exhausting means of transportation must be employed the explorer and scientist have not been deterred in their work. But dare we assume, with the present knowledge of geological and physical features, that it is possible to approximate the mineral value of the earth's crust? Little of this has been studied in sufficient detail to place reliable estimates of quantities; in fact, few sections known to contain mineral can be considered as having their reserves demonstrated, as necessity for such demonstration has been wanting."

At the present time the two features of an iron-ore deposit which attract favorable attention are the accessibility of the location and the high iron content, but Mr. Birkinbine shows that these are not necessarily controlling factors. The iron ores of the Lake Superior region were far removed from railroad connections until their operation rendered communication necessary, and now the district is covered with a gridiron of railway lines. In like manner modern improvements enable lean ores to be beneficiated to an extent which enables them to enter the field to advantage.

"The convenience of using ores rich in iron and the facilities for obtaining such material by purchase as wanted have encouraged the transportation of desirable mineral over long distances to furnaces close to which relatively inferior ores lie unused. The freight added to the selling price of these more desirable ores in some instances brings the cost of producing pig metal above what may be expected by using relatively inferior local ores. Iron ores from Minnesota reach Eastern blast furnaces with freight charges representing a cost of 4 cents or more per unit of metal, to which must be added the selling price of the ore, commissions, etc., and interest charges for winter storage. Four cents per unit will go a long way toward mining or beneficiating some ores convenient to blast furnaces which are generally overlooked in estimating reserves. These local deposits may have been wrought by methods in which labor saving appliances were not included, and a use of such methods may materially alter mining conditions. Dividing interest on capital, superintendence, management and fixed charges by a few hundred tons output per annum is quite different from using thousands of tons as a divisor. Many dormant deposits do not encourage the expectation of large reserves; others give indication that the deposits may prove important factors in the future ore supply."

Mr. Birkinbine reviews the estimates made for the Swedish government by Professor Törnebohm, in which the total supply of iron ore for the whole world is placed at 10,000 million tons, or about sufficient for the next 50 years. In this estimate Professor Törnebohm puts the United States down for a 1,100 million tons, this allowing 1,000 million tons for the Lake Superior region, 60 million for the Alabama brown hematites, and 40 million tons for the unmined ores of New York, Pennsylvania, New Jersey, and the western states. That these figures are far too low is evident when it is known that the Lake Superior deposits alone are estimated in the United States to contain 1,500 million tons, while large areas of valuable low-grade ore are not taken into account at all. It is probable that Professor Törnebohm is fairly correct for his own country, and yet he places these deposits as equal to those of Great Britain, twice as great as for Spain, and nearly as great as the United States. Apparently he has shown excessive caution for the deposits about which he has but a secondary knowledge, and his figures should certainly be held subject to revision for other lands than his own. This must be admitted when it appears that he has failed to recognize the known deposits of iron ore in Newfoundland, Canada, Mexico, Cuba, or South America, and but a very small allowance for Asia, and none for Africa. In view the rapid manner in which hitherto unknown deposits have been discovered in the United States during the past score of years, we cannot but believe that other parts of the world may be exploited in a similar manner.

"If we are to estimate the iron ore reserves for future use we must also consider their utilization in the future, a utilization which we have no right to assume will be kept within the limits of present industrial development or transportation facilities, nor even confined to prevalent methods of metal production. They are also to be estimated in their relation to the coal reserves if the

metallurgical processes of the present are to be followed. Such consideration may make available some ore deposits which are now remote from commercial centers or distant from exploited coal fields.

"The practicability of electric smelting of iron ore, which has been the subject of detailed study and report, may be of importance in the future, especially in the treatment of ores whose composition or physical condition is in the present status of knowledge undesirable for use in the blast furnace, and experiments with iron sands by the United States Geological Survey offer a possible reserve of iron ore of considerable importance. The same resource, ability and skill which have brought the iron and steel industry to its present status may be counted upon to overcome most of the objections to ores which are impure or distant, and with new metallurgical methods some ores now avoided because of certain elements in their composition may be in demand."

There is no doubt that such inquiries as have been made upon this subject are of much value, and that every effort should be made to ascertain the correct facts. Mr. Birkinbine has been altogether cautious and conservative, and his discussion only shows the necessity of having the ore reserves of each country estimated by an experienced investigator familiar with the actual resources of each region.

"The papers and discussions upon the probable exhaustion of iron ore supplies have served a good purpose in awakening interest in a subject of importance to all who produce, manufacture or use iron or steel. One result to be anticipated is that known deposits of iron ore classed as undesirable by reason of location, apparent volume, physical structure or chemical composition may receive consideration; that some now unopened may be exploited and others which have been wrought in the past may re-enter the list of producers, while encouragement to develop new sources of iron ore may come from the discussion.

"The fact that a number of ores considered unattractive by blast furnace managers can be made available has received more limited attention than would have been given had the better ores been more troublesome to obtain. But roasting pyritiferous ores has been followed for many years; more complete desulphurization and the nodulizing of comminuted sulphurous ores is practiced on a commercial scale; a large tonnage of magnetite is passed through magnetic separators to reduce the silica or phosphorus contents; and practical demonstration has shown that titaniferous iron ore when properly fluxed can be economically smelted. The field for such beneficiating and treatment is large and promises a considerable addition to the iron ore reserves.

"The problem is to be studied from the standpoints of deposits now exploited, of those unwrought, but concerning which ideas of their extent and character have been formulated by exploratory work, and of those whose locations are made known by prospecting, with allowances for probable iron ore supplies suggested by geological conditions.

"The United States by its phenomenal production of iron and steel and incident liberal use of iron ores has invited attention to the depletion of a mineral found in every State of the Union, and present in neighboring countries in volume such as to encourage faith in the future of iron manufacture on this continent. If the study of the iron ore reserves is undertaken in connection with present or possible fuel supplies, with consideration of prospective producing and consuming centers, the time when iron may be a precious metal or the available supply of iron ore become exhausted may be found so far in the future as to allay any anxiety."

This question of the possible exhaustion of the world's deposits of iron ore bears a resemblance to other alarmist predictions about the failure of various natural resources. It was only about a hundred years ago that Malthus predicted that the ratio of increase of population to food supply was such that starvation must soon overtake the world, but that dire fate seems as far off as ever. It is wise to examine carefully into our stock of natural resources, but this should be done rather to guide us in their exploitation than to predict an early impending evil.

THE ART OF INVENTING.

A STUDY OF THE EVOLUTION OF MECHANICAL INVENTIONS IN ACCORDANCE WITH SCIENTIFIC PRINCIPLES.

Edwin J. Prindle—American Institute of Electrical Engineers.

FORMERLY an inventor was supposed to be a sort of brilliant guesser, as often wrong as right, but occasionally hitting, practically by accident, upon some idea of much commercial value. That some inventions of important appear to have been made inadvertently appears to be true, but such examples are rare, and are growing more and more unusual; invention, at the present time, being almost a science, by which new combinations are deduced from observation according to scientific principles. The modern art of inventing, as relating to the devising of improvements in mechanical devices, has been treated in a very interesting manner by Mr. Edwin J. Prindle in a paper presented before the American Institute of Electrical Engineers, and some abstracts from it are here given as of permanent value. Mr. Prindle recognizes the broad meaning of the term invention, including, as it does the original work of the literary man, of the merchant, and of the investigator in general, but he purposely limits himself to the art of making technical inventions, and especially patentable inventions. The importance of encouraging this department of human industry is recognized by nearly all civilized governments by the manner in which they grant an absolute monopoly to an inventor for a limited period of time, in order to encourage him to add to the national wealth for all time thereafter.

"There is an enormous amount of wealth in the United States that is based upon patents. As an instance, might be mentioned the fact that the United Shoe Machinery Company is, by means of patents, able to control the sewing machines upon which ninety per cent. of the welt shoes in the United States are sewed. The Bell Telephone Company, and the Westinghouse Air Brake Company and many other corporations of the first importance built themselves up on patents. Patents have become so well recognized a factor in commerce that, in many lines of manufacture, concerns do not depend simply upon cheapness of manufacture, or quality of product, to maintain their trade, but they count on always having a product which is at least slightly better than that of their competitors, and which is covered by patents, so that they do not have to compete with an article of equal merit. And they keep a corps of inventors at work in a constant effort to improve the product, so that, when the patents now giving protection have expired, they will have a better article to offer, also protected by patents.

"Inventing has become almost a recognized profession. Many large concerns constantly employ a large corps of inventors, at liberal salaries. Besides the inventors employed by large corporations, there are many inventors who have maintained their independence, and are free lances, so to speak. Some inventors have become wealthy almost solely by their inventions, such as Edison, Bell, Westinghouse, Marconi, Pupin, Tesla, and Sprague. A considerable number of the smaller manufacturing concerns are built largely or wholly upon the inventions of their principal owners.

"Aside from the question of financial returns from inventing, the inventor has the satisfaction of knowing that he is a producer of the most fundamental kind. All material progress has involved the production of inventions. Inventors are universally conceded to be among the greatest benefactors of the human race.

"The art of invention is therefore one of great commercial and economical importance, and it becomes a matter of much interest to know how inventions are produced."

It is an interesting psychological study to inquire into the mental processes by which inventions are evolved, and in the course of his experiences with inventors of every class Mr. Prindle is able to furnish some very interesting notes upon this department of thought and work.

"It seems to be popularly believed that the inventor must be born to his work, and that such people are born only occasionally. This is true, to a certain extent, but there are many people who, without suspecting it, have latent inventive abilities, which could be put to work if they only knew how to go about it The large percentage of inventors in this country compared with all other countries, shows that the inventive faculty is one which can be cultivated to some extent. The difference in ingenuity is not wholly a matter of race, for substantially the same blood exists in some other countries, but it is the encouragement of our patent laws that has stimulated the cultivation of this faculty.

"The popular idea seems to be that an invention is produced by its inventor at a single effort of the imagination and complete, as Minerva sprang full grown and fully armed from the mind of Jove.

"It is, undoubtedly, true that every inventor must have some imagination or creative faculty, but this faculty may be greatly assisted by method. While reasoning does not constitute the whole of an inventive act, it can, so to speak, clear the way and render the inventive act easier of accomplishment."

It has been held that that which can be produced purely by processes of reasoning and inference is not an invention in the patentable sense of the term, but that the imaginative or creative faculty must be used somewhere in the process. It is this element in the operation which was so clearly indicated by Tyndall in his essay "On the Scientific Use of the Imagination," and as Mr. Prindle well puts it, it is the part of science to reduce the leap from the known to the unknown by means of the imagination.

After defining protectable inventions as falling within some one of the four classes of Arts, Machines, Manufactures, and Compositions of Matter, Mr. Prindle proceeds to define these classes and illustrate them by actual examples. In so doing he adds one more to the many definitions of a machine, one which will bear repeating as being briefer, and nearly as precise as the classical definition of Reuleaux. Reuleaux says: "A Machine is a combination of resistent bodies so arranged that by their means the mechanical forces of Nature can be compelled to do work, accompanied by certain determinate motions." Mr. Prindle says that a machine is "an assemblage of two or more mechanical elements, having a law of action of its own."

"Having selected a problem, the next step should be a thorough analysis of the old situation, getting at the reasons for the faults which exist, and in fact discovering the presence of faults which are not obvious to others, because of the tendency to believe that whatever is, is right.

"Then the qualities of the material, and the laws of action under which one must operate should be exhaustively considered. It should be considered whether these laws are really or only apparently inflexible. It should be carefully considered whether further improvement is possible in the same direction, and such consideration will often suggest the direction in which further improvement must go, if a change of direction is necessary. Sometimes the only possible improvement is in an opposite direction. A glance at the accounts of how James Watt invented the condensing steam-engine will show what a large part profound study of the old engine and of the laws of steam played in his invention, and how strongly they suggested the directions of the solutions of his difficulties.

"We now come to the constructive part of inventing, in order to illustrate which, I will seek to explain how several inventions were, or could have been, produced.

"The way in which the first automatic steam engine was produced was undoubtedly this—and it shows how comparatively easily a really great invention may sometimes be made. It was the duty of Humphrey Potter, a boy, to turn a stopcock to let the steam into the cylinder and one to let in water to condense it at certain periods of each stroke of the engine, and if this were not done at the right time, the engine would stop. He noticed that these movements of the stopcock handles took place in unison with the movements of certain portions of the beam of the engine. He simply connected the valve handles with the proper portions

of the beam by strings, and the engine became automatic—a most eventful result."

Mr. Prindle further illustrates the processes of invention by two concrete examples, one being the evolution of a special form of time-stamp, and the other a cord-knotter for a self-binding harvester, the successive details being well shown by illustrations, and closes with some remarks upon the fact, well-known to every inventor, that the mind proceeds, in nearly every instance from the more complicated to the simpler device.

"In inventing a machine to operate upon any given material, the logical way is to work from the tool to the power. The tool or tools should first be invented, and the motions determined which are to be given to them. The proper gearing or parts to produce from the power each motion for each tool should then be invented. It should then be considered if parts of each train of gearing cannot be combined, so as to make one part do the work of a part in each train; in short, to reduce the machine to its lowest terms. Occasionally a mechanism will be invented which is exceedingly ingenious, but which it is ,afterwards seen how to simplify greatly at the expense of its apparent ingenuity. This simplification will be at the sacrifice of the pride of the inventor, but such considerations as cheapness, durability and certainty of action leave no choice in the matter. It will sometimes be found that a single part can be made to actuate several parts, by the interposition of elements which reverse the motion taken from such part, or which take only a component of the motion of such part, or the resultant of the motion of such part and some other part. Where a machine involves the conjoint action of several forces, it can be more thoroughly studied, if it is found there are positions of the machine in which one force or motion only is in operation, the effect of the others in such position being eliminated, and thus the elements making up the resultant effect can be intelligently controlled."

MODERN PRACTICE IN REINFORCED CONCRETE.

OPERATIVE METHODS FOR CONTROLLING PROPORTIONS AND REDUCING COSTS OF STRUCTURES OF CONCRETE AND METAL.

E. P. Goodrich—Association of Portland Cement Manufacturers.

REINFORCED concrete has taken a place among the recognized methods of building construction to such an extent that experience is becoming crystalized into standard methods, and hence the time is at hand when the earlier empirical rules for proportions and details should be discarded. Apart from the general adaptability of reinforced-concrete construction to nearly all kinds of work one of its great advantages has been stated to be its moderate cost. The result has been, in some cases, too great a desire to secure cheapness, followed by failure and dissatisfaction, while in other instances the full benefits and advantages of the system have not been realized. In a paper presented at a recent meeting of the Association of American Portland Cement Manufacturers by Mr. E. P. Goodrich the best features of present practice are brought, with a special intention of discussing the elements involved in effective cost reduction of the finished work.

As an indication that some such discussion is appropriate at the present time, Mr. Goodrich gives some examples of extremes in the proportions of executed structures.

"One building has floors designed throughout 100 per cent thicker and with 100 per cent more steel than is necessary. Furthermore, 100 per cent more cement was used than was possibly required. In another piece of work a retaining wall of solid concrete 2 feet thick and 6 feet high was reinforced with five-sixteenth-inch rods spaced 2 feet apart. Of course, the rods will do no hurt in the wall. Happily, no danger is involved in those two structures, but many others exist which would long since have collapsed if loaded to any great percentage of what they are supposed to be able to support. One such building designed for floor loads of about 150 pounds showed signs of great distress when tested to only 75 pounds."

Mr. Goodrich shows that he appreciates

very clearly the fact that the highest mechanical efficiency does not necessarily mean the highest commercial efficiency, and the whole purport of his paper is to show how to secure the best structure at the minimum cost in money. In so doing he discusses both the materials themselves and the method of handling them.

"Of course, elements other than cement enter the problem to effect irregularities in tests, but it would be a great step in advance if cement could be so manufactured as to give as uniform tests as does steel. Then it would be possible for the engineer to reduce the larger factor of safety now demanded for concrete over that required for steel in reinforced concrete beams. Such a cement could actually demand a differential in price over the present qualities, and would be given it by many engineers. Another important point in which cement might be improved in its special relationship to reinforced concrete work, is its resistance to compression. The tendency for both mechanical and economic reasons now is toward the disuse of longitudinal reinforcement in concrete columns. But six, five, or even three-foot columns, such as are now necessary, are out of the question for most work and a much better grade of cement would receive an enthusiastic reception by all engineers.

"With regard to the item of strength of reinforced concrete, the ideal will be realized when the designer can so proportion the several parts that all will theoretically be worked to equal efficiencies, and those the maximum safe ones; and the superintendent of construction can so erect the structures as to conform exactly to the design prepared."

The quality of the cement being determined by specification, the controlling element in the quality of the concrete is the amount of cement used, together with the nature of the materials which it is used to bind together. The poorer the mixture the lower the cost of a cubic yard, but the cheapest concrete is not the most profitable, and the character of the mixture should be governed by the conditions of use. Mr. Goodrich gives diagrams showing the cost of different mixtures per pound of safe compressive stress, from which the selection may be made according to the nature of the structure and the character of the loading.

"Turning from the ingredients to the methods of handling them, three or four cardinal principles may be laid down with regard to the operations to be carried on.

"A fundamental principle to be observed in the handling of concrete materials is to make as much use of gravity as is possible. Especially in large work it is usually more economical to carry all materials to the tops of bins or other structures from which point they can move by gravity down through the mixer into the conveying devices. Every one is familiar with the high trestles, bins and other devices adopted on all large enterprises for the storage and handling of concrete materials.

"In general it may be said that the mixing should be done as near the point of installation of the concrete as possible, since it is easier and cheaper to handle the dry material than the wet mixture. In the case of one large building with structural steel frame, a small electrically-driven portable mixer was employed and moved about so that it discharged directly at the point where the concrete was to be placed. Electric power and water could be conveyed with ease to all parts of the building by wire and hose, and, with the structural work in place, the dry materials could easily be hoisted and conveyed to the mixer. This arrangement is perhaps ideal, but every effort should be put forth to make as short as possible the distance which the wet concrete has to be conveyed. Of course, the quantities to be handled, the time in which the work must be completed, and the height of the structure are the factors which determine most completely how much and what mechanical appliances can be used.

"The great point in arranging the labor in connection with a piece of work is to have an organization which will run like a clock. Such an organization will have no superfluous members, and will work with no irregularities of action. A few extra men to do nothing but maintain proper runs for the wheelers, can often actually effect a considerable saving of time and money. Under most conditions operations should be carried on in circles and cycles. Workmen should never turn abruptly and return over the same path, but should always return by

another road, thus completing a circuit and thereby preventing confusion and delay. By making all operations consist of simple cycles, each workman becomes expert in his duties and works most efficiently."

As regards hoisting the wet concrete or the moulded forms, platform elevators, bucket hoists, or derricks may be used, the choice depending so much on local conditions that no positive preference can be stated. The actual cost of the hoisting of the material is sometimes a minor element in the choice, the handling of other material, and the general value of the appliances to the contractor in his current work being often the ruling factors.

"The style and design of the steel reinforcement for concrete work is in no sense as well established as to economy and efficiency of design and construction as are the preparation and mixing of the concrete elements. There are at the present time a dozen or more fairly well-known systems, so called. The first tendency in this country was toward peculiarities of structure of the reinforcing bar so as to develop the adhesion between the steel and the concrete. At the present time the subject of adhesion is giving place to that of shear and the use of stirrups is receiving special attention in theoretical discussions. But even now the whole subject is assuming a phase in which theory is being largely modified by experimental results and practical conditions, and engineers are adopting short methods and thumb rules in making up designs. To be sure, they are not the same sort of rules as those so widely employed in some empirical systems, however closely the former may approach the latter. This is true because of the tedious study of theory from which the present practice has been derived."

Since the general introduction of reinforced concrete in construction, innumerable so-called systems have been introduced, the characterizing features of these being mainly in the form and character of the reinforcing material. As a matter of fact results of such excellent character may be attained by the simple methods long since open to the public, that it is unnecessary for engineers to do more than require materials of good quality to be used, and to dispose them in accordance with correct scientific principles.

"It is believed that at the present time the tendency is away from the use of special patented bars toward the use of plain round ones; and away from what may be designated as 'discrete' systems toward what may be termed 'unit systems.' It is believed further to have been demonstrated, in at least one special case, that such units can be fabricated and placed at just as economical costs as can be secured with any system using discrete members. While the same statement cannot be truthfully made with regard to lesser efficiencies of steels with a high elastic limit when the same is due to a large percentage of carbon, still it is looked upon with much distrust by many engineers, and it is believed that its use is not increasing with the relative speed that is being maintained by steel with low carbon. Where the increased elastic limit can be secured by cold rolling or twisting, many of the objections to steel with high carbon are groundless, but the very fact that smooth round rods of standard quality can easily be secured with less cost, time and trouble gives them a predominant advantage. Many engineers will not agree with these statements of tendency at the present day, but practice as described in current technical literature seems to point in the direction stated."

The most economical ratio of areas of steel and concrete to be used in beams has been a subject of much discussion, mathematical and otherwise, and it is evident that the highest efficiency, mechanically speaking, is attained when the concrete is stressed to the maximum compression efficiency at the same time that the steel is subjected to the maximum tensile efficiency. Mr. Goodrich gives several curves, showing the ratios of maximum mechanical efficiency and the highest commercial efficiency, the latter taking the question of cost into account, and in general it appears that the best ratio is between 1 per cent and 1½ per cent of reinforcement.

A very important element in the cost of reinforced-concrete structures is the cost of wooden centering and falsework. It is this point which renders it often more advantageous to use beams manufactured elsewhere than to build the entire structure from wet concrete on the spot. Even if

made on the ground, it will be found cheaper to form the columns, beams, and repetition parts in moulds on the ground, rather than to use the expensive amount of timber necessary to cast everything in position. A form of construction described in detail involves the use of brick curtain walls, with vertical slots left in the brickwork in which the columns which support the loads may be cast in concrete, with a minimum of wooden casing. Sheet metal moulds and core boxes may also come into use especially if standard sizes of columns and beams are adopted, as well as for large structures in which the amount of repetition work warrants the initial cost.

"Great care should be taken in the design of all centering, to make it as readily erected and removed as possible. It is believed that fully as much time can be profitably devoted in the office to the careful design of the centering for a job, as to the design of the reinforcement. As to the latter, it is believed that each beam and other member should be as carefully analyzed as are complicated plate girders. Regular strain sheets should be prepared and preserved for record, and all elements carefully investigated. Another point for careful study in the office is that of reducing to a minimum the number of types of beam reinforcement to be used on a building. This item is even more important than in the design of structural steel work, where it is made a cardinal point. Reinforcement and centering should be made interchangeable from bay to bay and from floor to floor as far as possible. Very often a design can be altered so that this can be effected with great economic advantage and with little or no loss of architectural or other feature."

THE FIXATION OF ATMOSPHERIC NITROGEN.

COMMERCIAL SUCCESS IN THE OXIDATION OF ATMOSPHERIC NITROGEN BY THE USE OF ELECTRIC ARCS.

Prof. Kr. Birkeland—The Faraday Society.

WE have already reviewed in the land and Eyde, in Sweden, in the columns the work of Messrs. Birkeconversion of the nitrogen of the air into commercial nitrates, suitable for fertilizing purposes, and now we have a fuller authoritative account of this important industry in the form of a paper presented by Professor Birkeland himself before the Faraday Society, which gives the present state of the process.

The principle upon which the process is based may be briefly stated as follows:

When two pointed copper electrodes, attached to a high-tension alternator, are placed equatorially between the poles of a powerful electro magnet, in such a way that the terminals of the electrodes are in the middle of the magnetic field, an electric flame will be formed in the shape of a flat disc. By keeping the electrodes cooled with a water circulation they will last for many hours, and practical experience has shown that a disc flame of this kind of about two metres in diameter may be maintained by a pressure of 5,000 volts, at 50 periods per second.

"The formation of these disc-flames may be explained in the following manner: At the terminals of the closely adjacent electrodes, a short arc is formed, thus establishing an easily movable and ductile current-conductor in a strong and extensive magnetic field, *i. e.*, from 4,000 to 5,000 lines of force per square centimetre in the centre. The arc thus formed then moves in a direction perpendicular to the lines of force, at first with an enormous velocity, which subsequently diminishes; and the extremities of the arc retire from the terminals of the electrodes. While the length of the arc increases, its electric resistance also increases, so that the tension is heightened until it becomes sufficient to create a new arc at the points of the electrodes. The resistance of this short arc is very small, and the tension of the electrodes therefore sinks suddenly, with the consequence that the outer long arc is extinguished. It is assumed that while this is taking place the strength of the current is regulated by an inductive resistance in series with the flame.

"The extremities of an arc may sometimes appear like glowing spots upon the

backs of the electrode. The spots of light on the positive electrode are small, and lie exceedingly close to one another, while those on the negative electrode are larger, and the distance between them is greater. The reason of the appearance of these spots of light is that the arcs, so to speak, melt or solder themselves to the electrodes, so that the magnetic force can only make the extremities of the arcs move along the electrodes in tiny leaps. It is evident from the curvature of the arcs that they cling more closely to the negative than to the positive electrode; and, therefore, the flame extends farther along the positive electrode than along the negative.

"When the flame is burning it emits a loud noise, from which alone an impression may be obtained of the number of arc formed per second in the flame. If the matter is to be more minutely investigated, this may be done by the aid of an oscillograph, by means of which the tension-curve for the electrodes, and the current-curve, can easily be drawn."

When a current of air is passed through such a disc flame a combination of a portion of its oxygen and nitrogen takes place, the result being a production of nitric oxide, and from this the production of commercial nitrates is a simple operation. In the Birkeland furnace the arrangement is such that the disc flame is formed in a vertical plane, the furnace being narrow, only 5 to 15 centimetres wide, the air being driven in at the centre from a pressure blower, and passing radially through the flame disc and conducted away through a peripheral channel. Although the temperature of the flame is higher than 2,500 degrees centigrade, the temperature of the furnace walls does not rise above 700 degrees, owing to the cooling action of the air.

"The nitric oxide fumes which are formed in the furnaces and conducted away with the hot gases, fixate, after cooling, a further quantity of oxygen from the unconsumed part of the air, and turn into nitric peroxide; and this, when treated with water, combines to form nitric acid.

"The volume of air thus treated at present in the Notodden saltpetre manufactory is 75,000 litres per minute; and as it contains only about 1 per cent of nitric oxide, it will easily be understood that in discussing the question of obtaining nitric acid from the air, it has frequently been pointed out that the great rarefaction of the gases to be worked with, greatly enhances the difficulties of the problem to be solved.

"The gases that come from the furnaces with a temperature of 600°C. to 700°C. first pass through a steam boiler, the steam of which is employed in the further manufacture of the ultimate product, calcium nitrate. In the saltpetre manufactory now in course of erection, the gases will be conducted directly through the evaporation tank, an arrangement which implies such an important saving of heat, that the employment of coal may presumably be avoided.

"After the gases are discharged from the above-mentioned steam boiler, their temperature is reduced to 200°C, whereupon they are conducted through a cooling apparatus to be further cooled to about 50°C. The more the gases are cooled, the more easily are they absorbed by water. The gas then enters two large oxidation chambers with acid-proof lining. Here, as already mentioned, takes place the oxidation of the compound formed in the furnaces, nitric oxide becoming nitric peroxide, which is then conducted farther into an absorption system, where the gas is converted into nitric acid.

"The absorption system consists of two series of stone towers, whose internal dimensions are 2 by 2 by 10 metres, each series containing five towers, two of granite and two of sandstone, filled with pieces of quartz, over which water, and the nitric acid formed, are made to trickle, while the fifth tower in each series is filled with ordinary bricks, over which trickles milk of lime. The milk of lime quickly absorbs the rarefied nitrous gases remaining, and is converted into a compound of calcium nitrate and calcium nitrite.

"The first tower yields a 50 per cent nitric acid, the second about 25 per cent, the third 15 per cent, and the fourth 5 per cent. The liquids from the fourth tower are raised by compressed air to the top of the third, those from the third to the second, and those from the second to the first, thus gradually increasing in concentration up to 50 per cent., at which density the acid is conducted into a series of open granite tanks, where it is temporarily stored.

"Some of this acid is employed in the decomposition of the nitrate-nitrite combination obtained by absorption by milk of lime. By the addition of nitric acid the nitrous anhydride contained in the nitrite is driven out and carried back to the system of towers.

"The solution resulting from this, containing pure calcium nitrate, is carried, together with the rest of the stored-up acid, into another series of granite tanks, where this mixture of acid and acetous calcium nitrate lye, reacting on ordinary limestone, is converted into a solution of neutral calcium nitrate. This neutral lye is carried farther into vaporisation chambers of iron, where it is vaporised to a boiling point of 145°C., answering to a concentration of from 75 to 80 per cent of calcium nitrate, containing about 13.5 per cent of nitrogen. This substance is then run into iron drums containing about 200 litres, where it congeals, and in that form appears on the market."

Experiments made with the calcium nitrate as a fertilizer show it to be fully equal to the natural saltpetre, and if the process for its manufacture can be conducted at a cost which is commercially practicable the problem of the production of an artificial fertilizer for grain may be said to be solved.

While full disclosures of operative costs cannot be expected, Professor Birkeland gives enough information to show that the process can be operated so as to enable the product to be sold for £8 per ton, the works cost being about one-half this amount. It appears that the output of the present furnaces corresponds to between 500 to 600 kilogrammes of anhydrous nitric acid per kilowatt per year, so that, the cost of power being determined, the other costs should be capable of determination.

The new works, now nearly completed, are to obtain 30,000 horse power from the falls at Svaelgfos, and when this is in operation is is expected that closer cost data will be forthcoming. In the construction of these works it appears that the cost per kilowatt for the erection of furnaces, is £1,000, fully complete, including inductive resistances, ready for connection to the alternating current, for a 1,000 kilowatt furnace, so that a basis for the installation cost is also given.

Professor Birkeland concludes his paper with a valuable theoretical study on the oxidation of nitrogen, with photographs of the flame, and data of experimental researches, his conclusions leading him to believe that the action is a thermal rather than an electrical one.

COMMERCIAL DRY DOCKS.

A STUDY OF TYPES, DIMENSIONS AND DETAILS OR DRY DOCKS FOR THE HANDLING OF MERCHANT VESSELS.

J. M. Moncreiff—North-East Coast Institution of Engineers and Shipbuilders.

NEARLY every department of engineering work is so intimately bound up with some other portion that is impracticable to consider one thing without necessarily taking many others into account. The present tendency in shipbuilding is an excellent instance of the truth of this statement. Vessels are being constructed of greater length beam, and draught than ever before, in accordance with the demonstrated fact that large vessels and the most profitable of cargo carriers. But large vessels mean enlarged harbors, deeper channels, greater handling facilities, and larger docks. This latter question, the construction of dry docks for modern merchant vessels, formed the subject of an important paper, presented several months ago by Mr. J. Mitchell Moncreiff before the North-East Coast Institution of Engineers and Shipbuilders, and followed for several meetings by an animated discussion. While Mr. Moncreiff discusses principally the conditions existing on the Tyne, the principles of constructions brought out in the paper and in the discussion are of such general applicability as to merit review and comment in these pages.

Taking up first the question of dimensions, Mr. Moncreiff begins by showing that a dock of 550 feet length, by 65 feet width of entrance, by 14 feet depth over the sill at low water and 29 feet at high water could probably deal with every commercial

vessel ever cleared from the river Tyne up to the end of 1904, and he believes that only a moderate increase over these dimensions should be provided at the present time. For other ports, however, the record of vessels entering and building should be taken into consideration, especially as to width and depth, and that the plans should include provision for future lengthening, this being the dimension in which further immediate increase is likely to be expected.

Dimensions having been determined, the next question for consideration is that of site. This, however, is not usually a matter of selection, but rather of utilization of land already available, its nature having important influences upon the design of the structure.

"Where, however, it is possible, the selection of the site should be done in the most careful manner, and the mere fact of a certain piece of land being obtainable at a reasonable figure should not be allowed to be a ruling factor in coming to a decision. Instances are not wanting of docks, which, from lack of proper consideration and enquiry, have been saddled with heavy capital outlay which taxes their dividend-earning powers to the utmost. In every case numerous borings should be taken over the proposed site, and the small outlay required would be amply repaid by the greater certainty and accuracy with which the designs could be got out and by the greater confidence with which contractors would be able to fix their prices when tendering for the work. The omission to take a sufficiency of borings leaves an open door for claims for heavy extras.

"The character of the subsoil of a site has very great influence on the design and cost of a dock. Generally a rock bottom is most to be desired, but this is not an invariable rule; hard boulder clay is excellent, while the softer clays, alluvial deposits, ground of mixed character, and water-bearing sand, give most trouble during construction. Instances of some of these will be described later. In choosing a site it should be kept in mind that it is a great advantage for a dock company to have more than one dock, or at least to have a site which will allow of more than one dock being constructed upon it. It is also a great advantage for dry docks to be associated with a shipyard for reasons which are sufficiently obvious.

"If possible there should also be provided a repairing berth with ample depth of water, and a wharf at which such repairs may be carried out or completed as do not necessitate the vessel being in dock. The site should have room for the various workshops, stores, and offices required."

In order to show the influence of the character of the subsoil upon the design and cost of a dock Mr. Moncreiff discusses the cross sections of several docks which have been actually executed. When the site consists of rock, capable of carrying heavy loads with safety, and not sufficiently permeable to permit serious upward pressure from water, the construction becomes greatly simplified. The bottom need be only sufficient to insure tightness and a smooth surface, while the lower portions of the walls form struts to support the upper portions subjected to the overturning efforts of earth and water pressures behind. When the bottom is not so good its defects must be remedied by heavier artificial structures, and Mr. Moncreiff gives several examples of such construction for different kinds of soils.

"In determining the cross section of a commercial dock the inner contour is designed almost wholly with regard to having a sufficient clear space around and under a vessel to allow paint to dry quickly, to provide room and light by which repairs can be carried out with ease and promptitude, and to give altars for the support of shores. It is now customary to provide only a few altars in the upper half of the wall face, of such width and height that workmen can pass with ease and safety from one to the other or along any one of them. At the foot of the wall one or two low altars are sometimes also provided, but their function is not solely that of an altar properly so called, but also that of a toe to the dock wall.

"The large number of altars provided in most of the older docks, and the consequent great width between the copes, are not necessary or desirable at the present time. The great width at the copes would cause much unnecessary pumping, and the great distance of the copes from the centre line of the dock, and consequently from vessels

in the dock, would require cranes of very large radius, and this of course would entail extra weight and size of cranes to give sufficient stability. In addition to these inconveniences, an excessively wide dock takes up valuable space which might be otherwise occupied.

"Steps or reductions in thickness should rarely, if ever, be made at the back of dock walls, as it is almost impossible to prevent some little movement of the backing if the wall back be not built hard up against the earth face so as to avoid having to remove timbering to put in filling."

Mr. Moncreiff discusses at length the important question of the construction of gates for dry docks, especially in connection with the relative values of gates and caissons.

"The gates may be of wood, iron, or steel, or of a combination of these materials. For the smaller class of docks, say with entrances of not more than 45 feet wide by 25 feet total depth from cope to sill, pitch-pine timber gates are quite satisfactory, and are also very durable except in situations where the ravages of marine worms are to be feared. For the larger commercial docks timber gates are too heavy and cumbrous. Composite gates having iron or steel ribs with timber planking are also sometimes adopted and are very economical in first cost. For the larger and more modern docks, however, the gates will usually require to be of steel or iron throughout, in order to provide the strength required to sustain the great depth of water over the sill at high tides, and at the same time to be comparatively light and easily worked. It has sometimes been urged that the timber gate, by reason of its greater mass and solidity, is superior to the steel or iron gate in the event of being struck by a vessel; but this advantage is more imaginary than real, and there is no reason why gates for commercial dry docks should be specially made to resist collision any more than the vessels which the dock is constructed to contain. If this principle of making structures capable of resisting any and every possible contingency were to be carried out consistently, it would result in an enormous and unnecessary waste of money."

So far as operative machinery is concerned, it appears to be possible to go too far in this direction. Some docks are equipped with expensive hydraulic or electric machinery for the operation of the gates, but the time saved by such appliances is so small as to render but slight return upon the original cost. The gates of any modern-sized dock can be opened by hand gearing in three or four minutes, and if a little higher speed be desired it can be obtained by the aid of an ordinary steam winch or electric capstan. Even if special motive power is installed an auxiliary hand gearing should be provided.

"A matter which has very frequently been discussed is the question of the relative advantages and economy of caissons as compared with gates. There cannot be a doubt as to which is the less costly, even if the caisson be merely swung out into the river without any special provision in the nature of a caisson-chamber. If the latter be also provided it will, in the case of the large docks now required, add a very large sum to the first cost. It is to be remembered also that the chamber for the caisson must necessarily be placed at the very point where it is most desirable to avoid any unnecessary constructive work, that is, just at the very entrance of the dock, and it will entail a much larger coffer-dam than would otherwise be required and will increase the risks which are inseparable from the construction of the river-end of any dock.

"It is more than 150 years since Belidor strongly urged that the entrance of a dock should be the first part to be constructed. This is now more than ever necessary, in view of the far greater depths to which both permanent and temporary works have to be carried, and there is, at the present day, every reason to endorse Belidor's opinion, in order to avoid working for any lengthy period behind a temporary coffer-dam. It is, therefore, for a commercial venture, a mistake to increase the constructive work to be done at the river-end of a dock, unless some very substantial advantages are to be afterwards gained. In general there are not sufficient advantages in the provision of a caisson-chamber to justify the extra expense and risk, and having regard to all the circumstances it appears that the balance of advantages is very greatly in favour of gates as compared with caissons, at least for commercial enterprises.

"It is sometimes claimed that a longer dock can be obtained with a caisson than with gates, but this is not found to be correct in practice. Gates are undoubtedly much less costly, they are handier and quicker in working, they are not liable to get adrift, and they do not require special pumping engines and boilers, and special men to attend to them."

The pumping machinery for dry-dock service demands no especial attention, except that it appears more than probable that electric power will be found increasingly available, thus dispensing with a large portion of the steam-power plants hitherto necessary at locations where much inconvenience was caused and valuable land occupied.

The use of concrete for dock construction is unhesitatingly advocated by Mr. Moncreiff in connection with a strong appeal for the highest class of work. Concrete is attacked by sea water if it is not of the best, and the work executed in the very best manner. The walls should be faced with a hard brick skin, and the tops of the altars and the copes should be of granite. This adds materially to the cost, but the best is none too good in such work.

In the course of the discussion it was brought out that for general service modern dry docks should be built capable of dealing with vessels 800 feet long and 80 feet beam, and it is a question whether even these dimensions are not soon to be exceeded. The question of floating docks was also discussed at length, and it appeared that these are distinctly more costly than dry docks in first cost, but not necessarily so in operation.

THE GOLD PRODUCTION OF THE WORLD.

CAUSES AND METHODS INVOLVED IN THE ENORMOUS INCREASE IN THE PRODUCTION OF GOLD DURING THE PAST DECADE.

L. de Launay—Revue Générale des Sciences.

ALTHOUGH it is known in a general way that the production of gold in all parts of the world has shown a rapid development in recent years, the details of the increase are not readily available in compact form, and hence two papers by M. L. de Launay, an eminent French mining engineer and professor at the Ecole Supérieure des Mines, published in recent issues of the *Revue Générale des Sciences,* demand present attention. M. de Launay treats the subject, first from a statistical point of view, and, second, as a geologist and mining engineer, and some review of both portions of his discussion will be given.

The enormous increase in the rate of the production of gold is one of the remarkable industrial and economic phenomena of the present time. The curves representing the production of other metals have shown upward tendency, more or less marked, but the line showing the gold production of the world shows such a remarkable upward tendency that at times it almost approaches the vertical. When the curve is separated into its three components, representing respectively the three principal sources, the Transvaal, the United States, and Australia, it is seen that there is a marked similarity between them, interrupted only by the break due to the war in South Africa. The figures for the year 1905, as given by M. de Launay, in francs, are: Transvaal 524 millions; Australia, 432 millions; the United States, 436 millions; a total of 1,392 million francs; or about 278 million dollars, or 55 million pounds sterling! These three countries produce 72 per cent. of the world's total, which reaches 1,908 millions of francs, and it is expected that this present year 1906 will see a production of two milliards of francs. An industry which in 1884 produced less than 500 millions, and which, in about twenty years has attained four times that amount, stands, as regards its rate of development, above all other metallurgical industries, iron alone excepted.

The causes for this development are shown by M. de Launay, to be various. Doubtless, the general tendency toward colonial expansion has had a strong influence in the increase in gold mining. The principal cause, however, appears to be an economic one. Apart from the fascina-

tion which appears always to have accompanied the mining of gold, there is the all-important fact to the producer of the precious metal that he does not have to seek a market for his product. Apparently there is for it an unlimited market at an unvarying price. This invariability in price is only apparent, since any sudden increase in the production of gold, the accepted monetary standard, would necessarily be accompanied by a corresponding fluctuation in prices. This, however, does not immediately appear, and while the miner does find an immediate market for his product, the economist may consider that which shall occur when the world will be saturated with the metal which is at the same time a commodity and a standard of value. The fact that one nation after another has adopted the single gold monetary standard has undoubtedly stimulated the exploration of all parts of the world, and with the recently developed methods by means of which low grade deposits may be worked to advantage, there is every reason to believe that the production of gold will continue at an increasing rate.

M. de Launay examines the distribution of the gold production of the world in the past, as well as at the present time, showing the recovery of the Transvaal after the Boer war, and the development of the Yukon and the Nome districts in Alaska, together with the revival of gold mining in Mexico.

It is estimated that the total amount of gold produced between 1500 and 1848 in South America, Africa, Russia, and Hungary represented about 15½ milliards of francs. From 1848 to 1889, after the discoveries in California and Australia there was produced 24 milliards, and from 1889 to 1906, since the opening of the Transvaal, about 20.56 milliards, or a total of 60 milliards of francs in gold, or approximately, 17,600 metric tons.

In examining the geological conditions accompany gold mining operations, M. de Launay shows the small proportion of rich deposits, and emphasizes the fact that the production has been closely localized. It has already been stated that the total amount of gold produced from ancient times down to the year 1906 corresponds to only about 17,500 metric tons, with a value of about 60 milliards of francs. Comparing this with the annual weight of iron and steel products, and taking ten hours to a working day, it appears that the total weight of gold in the world is about equal to one hour's product of the iron and steel industries. In speaking of the enormous production of gold at the present time, therefore, the term must be considered only as relative, and used in connection with that of earlier periods.

M. de Launay examines the different conditions under which gold is found, showing its relation to granitic and volcanic rocks, as well as to secondary formations, placers, etc., and proceeds to discuss in a general way the industrial methods for the extraction of gold. These include the earlier appliances for washing the auriferous earth of placer deposits, down to the modern dredge, travelling in a pond of its own excavating, and working deposits too lean to be profitably handled in any other way.

The treatment of free milling ores, the use of the cyanide process, and the chlorination method are also discussed.

It is largely because of the improved process of extraction that the production of gold has increased at the rates already given, since it is by the wholesale application of modern methods that the lowest grade deposits can be commercially worked. Thus, in a large and accessible mine it is assumed, on an average, that the material can be treated for about 12 francs per ton. Very often, however, the cost reaches double this figure, according to location and operative difficulties. In the great workings in Dakota, on the contrary, the cost has fallen as low as 2.10 francs per ton, and at the Alaska Treadwell mine, to the minimum of 1.12 francs.

In the Transvaal, using the cyanide process, the cost of mining and treatment varied from 22 to 80 francs per metric ton, averaging 32 to 35 francs in 1895. Since the Boer war the cost has increased, but it is believed that improvements will cause the expense to be reduced. A portion of the expense in South Africa is due to local causes, and at the Homestake mine, in Dakota, where the cyanide process is also used, the cost does not exceed 8.50 francs per metric ton.

THE ORIGIN AND FORMATION OF COAL FIELDS.

AN EXAMINATION OF THE CONDITIONS SURROUNDING THE CONVERSION OF PRIMEVAL VEGETATION INTO COAL.

James Ford—Iron and Coal Trades Review.

IT is generally understood that the coal fields of to-day owe their origin to the forests of an earlier period in the earth's history, but there are numerous misconceptions as to the conditions under which the change took place. At a recent meeting of the National Association of Colliery Managers, a paper was presented by Mr. James Ford, showing how the formation of coal measures may be traced in existing remains, and from this paper, as published in the *Iron and Coal Trades Review,* we make some extracts. Mr. Ford very properly maintains that it is unnecessary to assume the existence or operation of any other forces and laws in the past than are in action at the present time, believing that it is entirely practicable to explain the formation of coal deposits upon the application of existing conditions.

"It has been quite a common thing in endeavours to account for the existence of such vast masses of vegetation necessary to form the great thickness of our coal seams, to imagine some vast forest growth in quite abnormal climates, and the existence of laws and forces other than at present within the range of man's knowledge; the most prevalent idea being that in a very remote period of the world's history there flourished large forests, the like of which has never been seen in our day, and that these forests sank under the water just as they stood, and, becoming covered over by sediment brought down by water, became changed into a seam of coal. This is quite an erroneous idea, and there is, to my mind, no evidence whatever of any growing forest ever being changed into a seam of coal.

"The supporters of this theory appear to attach great significance to the presence of stigmaria rootlets said to be found in the underclays of the coal seam, and the existence of trunks of the sigillaria tree, and other fossil impressions in close vicinity to the coal, but who has ever discovered any stigmaria roots or a sigillaria trunk in a coal seam? Any traces of roots in the underclays are exceedingly rare, and even then are only grasslike markings which do not in any way affect the distinct parting or parallelism which severs the coal so distinctly from its underclay bed. There is certainly no indication of any plants or trees which may have formed part of the vegetable mass which eventually changed into coal, having roots penetratig into the underclay. I have known of solitary fossil tree trunks with roots attached, and standing erect in or near the coal seam, but these are so rare as to become objects of great interest. They are there by accident, and have had nothing whatever to do with the formation of coal. These trunks have not formed coal at all, but only fossils made up of the small material that formed the roof of the coal seam. They are probably the fossilised remains of solitary trees growing in the vicinity of the area in which the coal vegetation was forming, and are merely incidental and contemporaneous with the period, but were as foreign to the true origin of coal as the overlying roof material. In fact, the most perfect examples of these fossil trees, and the greater number of them, are found in the beds of strata overlying the coal seam and not in the seam itself.

"If it were otherwise, and the vegetation of which the coal is formed consisted of erect timber growing *in situ* in the shape of immense trees having their roots in the underclay, the floor of the seam would necessarily be rough and uneven, because if the trunk of the tree made coal, the butt and the root should do the same, whereas, instead of this added difficulty to mining operations, we have a sharp dividing line with the plane of stratification generally quite smooth. To my mind it is positively certain that the coal vegetation never had roots penetrating into the underclay. The absence of butts or roots in the underclays and the distinct severance of the coal and the underclay is conclusive evidence that no standing timber ever grew there.

"All fossil impressions, whether of trunks of trees, or smaller vegetation such as ferns, mosses, etc., and other organic life belong-

ing to the period, are generally found in the strata lying immediately above the coal seam, and seem to have been conveyed there by the forces which brought the sediment covering the coal seam, and only serve to indicate the kind of flora and fauna of the period. The structure of the coal itself is also opposed to this theory. If we examine a piece of coal, we find its structure is strictly laminated; that is, composed of regular layers which lie parallel to each other, and this parallelism is uniform throughout the whole section, finishing off completely and distinctly where the roof of the seam begins. The parting between the coal and the roof is, in fact, as clean and distinct as the leaves in a book. This arrangement could not have well taken place with standing timber of a mixed growth and uneven size. There would have been irregularity in the laying out of the roof over an irregular growth. Besides, the mixing of the material which formed the roof (which in most cases seems to have been very fine sediment), with the open tops of the standing trees, would have merged the one into the other, and we could not have had such well-defined partings between the roof and the coal as we are all so familiar with."

The microscope gives clear and decisive evidence of the vegetable origin of coal, and we are entirely justified in saying that coal has been formed from the accumulation of vegetable matter which has undergone chemical and physical changes, due to heat, pressure, and chemical action. The real question for investigation is the manner in which the great accumulations of vegetable matter were formed, or, in other words, how the coal *seam* was formed. The best clue to this is a study of the seam itself, as it is found to-day.

A coal seam is generally horizontal, and of fairly uniform thickness and character, with a distinct parting between the seam of coal itself and the roof and floor. In general the floor, or seating is of clay, and the roof of shale or slate, and the appearance of the seams themselves, and the floor and roof, is practically the same in all parts of the world. The appearance of such a seam is almost conclusive evidence that it was not formed directly from a growing forest. Mr. Ford is inclined to think that the action of the microscopic forms of plant life known as the *desmidiaceae* have acted to form vast masses of carbonaceous matter, much in the same manner as diatoms have secreted silica, and other microscopic organisms have produced chalk and coral masses.

"Next to the action of microscopic vegetable life, our nearest analogy to a coal seam is a peat bog, which we can all examine at first hand for ourselves, and which presents almost precisely the same phenomena as our coal seams. Immense swamps, with bottom heat and a moist, warm atmosphere above, and covering hundreds of miles with a rapidly growing mossy vegetation—not at all dependent on the underlying stratum, except that it should be one that held water, and made it comparatively stagnant, such as our underclays would be—would grow feeding on the water alone, with immense rapidity, and filling with their innumerable tissues every space from top to bottom, thus form a mass of solid vegetation with all the conditions favourable and ready for the subsequent changes necessary for its conversion into coal. These bogs of peat can actually be seen growing and forming to-day, ranging in thickness from 20 to 40 feet. They are not by any means rare, and their rate of growth in our day has been observed in different situations to vary from less than a foot to about 2 feet in 10 years. From observations which I was enabled to make on this matter for myself, I found that in a period of from 15 to 20 years a layer of fine vegetable matter, similar to peat, had formed to a thickness of 3 inches from the yearly accumulation of grass seeds alone, in a small depression of the ground, some 60 yards in area. There was a clay bottom, and the sloping sides of the ground were never mown, but were allowed to run wild, and the yearly growth had apparently been washed through the turf in the middle of the hollow and deposited on the clay bed underneath, where it had formed to the thickness I have stated, a pure vegetable deposit.

"From my own observations in this small incident, and the inspection of peat deposits, and from the conclusions of science as to the important part that microscopic creatures have played in piling up vast deposits, I am convinced that the vegetable matter

which has gone to the formation of our coal seams has been brought into being in this way. At any rate, the balance of evidence is in favour of this theory, as it will account for all the phenomena we meet with in connection with our coal deposits in a way no other theory will. By this theory we are able to explain satisfactorily the horizontality, the variation in thickness, the existence of the clear, distinct parting at the roof and floor of the mine, and the general uniformity in the structure of the seams. The different thickness of vegetable accumulations would, of course, give a different thickness of coal. The clear partings are accounted for by the fact that the vegetable mass has no roots and no tops; the bottom being simply a material that should hold the water necessary for its growth. The underclays are evidence in support of this. The bands of dirt partings in coal seams are evidences only of a temporary cessation of that particular growth, caused by some terrestrial, or geological, changes with a subsequent return to the former conditions. We are able also to understand how it is that coal is so widely distributed in all parts of the world and in various geological periods, as the only conditions necessary are large sheets of inland water and ordinary atmospheric influences.

"Briefly, then, the coal seams as now found were once vast swampy peat bogs or masses of vegetation forming in immense areas of standing water, accumulating for long periods of time and in favourable climatic conditions, after which the land gently subsided, and the accumulated vegetation became covered over with a layer of mud, or sand brought down by rivers from more elevated places, or an encroachment of the sea; and then as time flowed on, either from the large amount of sediment brought down, or from the gradual uprising of the land, this new surface would again be exposed to the favouring conditions of light and heat, and other harvests of vegetation would grow and accumulate, and they also in turn would become covered over in a similar manner. This phenomenon would occur again and again, and as a matter of fact is still taking place, and thus numbers of coal seams have been formed and brought within man's reach.

WATER-TUBE MARINE BOILERS.

THE REPLACEMENT OF CYLINDRICAL BOILERS BY THE WATER-TUBE CONSTRUCTION IN NAVAL SERVICE.

W. L. Cathcart—Technology Quarterly.

WATER-TUBE boilers have come into very general use for land service, and numerous attempts have been made to design satisfactory marine boilers of this type. The difficult conditions of marine service, however, have led to delays of various kinds, and it is only recently that it had been admitted by marine and naval engineers that the water-tube type of boiler was really adapted for general service at sea. In a lecture delivered before the Naval Architectural Society of the Massachusetts Institute of Technology, Mr. William Ledyard Cathcart, himself a former engineer in the United States Navy, and eminently qualified to discuss this important subject, reviewed the development of the water-tube boiler in marine service, and from his address, as published in the *Technology Quarterly*, we make some notes and abstracts.

Mr. Cathcart maintains at the start that practical experience as well as scientific tests, have demonstrated the unquestionable superiority of the water-tube type for all naval uses, and he predicts that the displacement of the fire-tube type will also be effected for marine service generally. This prediction is based on a careful analysis of the conditions of the generation of steam, and it is from Mr. Cathcart's examination of this part of the question that we make some abstracts.

"There are two stages in the generation of steam: combustion in the furnace and transmission of heat in the boiler proper. The first of these actions is similar in all boilers; in the second there is a marked difference between the fire and water-tube types in this, that in the former the gas currents, after leaving the furnace, are subdivided within tubes which the water

surrounds, while in the latter the reverse is the case, the water and steam passing through the tubes. Let us consider the effect of this difference upon heat transmission through heating surface.

"The laws governing such transmission in a boiler of any class are, as a whole, but little known. The final result is the effect of several actions: convection currents and slow internal conduction in the gases, transmission by convection and exterior conduction from gases to metal, internal conduction within the latter and external conduction from it to the water, and, finally, convection currents and feeble internal conduction within the mass of the water or mingled water and steam.

"As to this complex series of operations, there are known only the law of heat transmission through the metal, the conductivity of water and, approximately, that of the gases. The former conductivity is, according to Lord Rayleigh, 115 times less than that of iron, while according to other investigators it is about thirty-five times greater than that of the combustion gases. While this evidence is indirect, it seems clear that heat passes with much greater difficulty from the gases to the metal than from the latter to the water—a deduction which test observations support, since they show always a much greater difference of temperature at the fire side than at the water side of the metal."

The differences in temperature are vital factors in the transmission of heat, and with this difference in temperature must be considered the movement of the water in the boiler—its circulation.

In the older types of cylindrical boiler the circulation was irregular and uncertain, but in the water-tube boiler the circulation is controllable, depending on the arrangement of the tubes. According to the classification of Bertin, the circulation may be: limited, as in the Belleville boiler, corresponding only to the entrance of feed water to replace the evaporation; free, due to slightly inclined tubes, the steam escaping freely from the heating surface by its own motion; and accelerated, in which the tubes are nearly vertical, causing a maximum velocity to be attained, in connection with down-comer pipes for the return flow. The D'Allest boiler is an example of the second type, and the Yarrow, of the third. In general it is believed that a good circulation is essential, and that the efficiency of a boiler, within certain limits, increases with the speed of the circulation.

"Increase in temperature difference gives, *per se*, a rise in heat transmission; but if the results of these two series of experiments be accepted it is clear that at a constant temperature difference a greater velocity of the water augments the rate of heat transmission.

"Boiler economy is, however, dependent, not only upon the efficiency of heat transmission to the water, but also upon that of heat transmission from the gases. Granting that a greater velocity of the water makes possible a higher rate of heat transmission to it, there must be secured, also, a proportionate rise in heat transmission from the gases in order to obtain an increase in boiler efficiency corresponding with that in water speed.

"In discussing these conditions Professor John Perry, F.R.S., said:

"'One small tube conveying hot gases, dragged through at an enormous velocity, and a concentric tube conveying water in the opposite direction at great velocity—they had in that combination a method of giving up heat which was fifty times as great as what occurred in an equal amount of heating surface in the best existing boilers.'

"This combination would be, theoretically, most advantageous, especially in its control of the direction and in its minute subdivision of the gas currents, which subdivision would act to offset the low conductivity of the gases. It represents, in effect, the views of Péclet and Rankine carried to what would be a logical but, at present, impracticable extreme.

"The difficulty of effective abstraction of heat from the gases is the limitation which prevents the increase in efficiency otherwise possible by extreme speeds in water circulation. Practically, therefore, all that is necessary is a circulation which is sufficient to sweep away bubbles of steam from the heating surface, thus preventing overheating, which is active enough to keep all water in the boiler at about the same temperature, and which is absolutely free, so that when required the boiler may be forced

to the limit fixed by its heating surface, combustion space, and baffling."

If the circulation is sufficiently free, the heat transmission at the water side of the heating surface may be considered as sufficiently rapid to transfer at once all the heat received by the metal, so that the relative efficiency of a boiler depends upon the effectiveness of the heat transmission from the gases. The difficulties to be contended with in this operation are two-fold; being the low conductivity of the gases, and the brief duration of the contact of the gases with the heating surface. The theory of Rankine is that the currents of heated gases and of water should move in opposite directions, but in order to obtain the full benefit of this it is necessary that the mass of the gases should be broken up into sheets sufficiently thin to overcome their low conductivity. This means that effective baffling should be provided, a problem not always easy of solution, especially with some designs of water-tube boilers.

"With regard to heat transmission, any water-tube boiler having a circulation sufficiently free or accelerated is superior to the marine cylindrical type in so far as the water side of the heating surface is concerned, owing to the subdivision of the water within tubes and the active and sustained circulation. As to the gases, however, the reverse is the case in general, since in the cylindrical boiler the total volume of the gases is not only subdivided in tubes, but retarders may be used, as in the Howden system, to combat low conductivity and increase convectional action. Whitham, in trials of a horizontal fire-tube boiler, found that these appliances gave an economic advantage when the boiler was pressed, varying in his tests from 3 to 18 per cent.

"Hence in water-tube boilers generally the heating surface is not, as a whole, as effective as that of the cylindrical type, although portions of it, where the gas circulation is most favorable, are unsurpassed in efficiency A thorough system of baffling, however, in such boilers as are fitted for it overcomes largely the difficulties with regard to the gases."

Mr. Cathcart gives much space to a description of the Babcock & Wilcox water-tube marine boiler, as a form already in extensive use, showing how, in its design, the scientific requirements of marine service have been met, and proceeds to give some examples of the operation of such generators in actual service. One of the special advantages of the water-tube boiler in naval service appears in the ability to raise steam promptly, and data from tests on the *Cincinnati* show what has been done in this direction.

"In the *Cincinnati* tests fires were started on a cold boiler, lightwood being used and the blower running (closed stokehold system). Steam formed in five minutes, and in twelve minutes forty seconds had reached a pressure of 215 pounds gauge. To raise steam in the cylindrical boiler, without special appliances for circulation and without endangering its complex structure, requires from five to ten hours, depending mainly upon whether the boiler is single or double ended.

"Rapidity in raising steam, which is a characteristic of the water-tube boiler in general, is, in navies, of the greatest tactical value. It is a well-known fact that owing to the inherent defect in this respect of the cylindrical boiler the American fleet was, as a whole, unprepared for steaming at full speed when Cervera's squadron made its dash from Santiago. If the ships had been fitted with water-tube boilers the difficult problem which confronted the fleet in maintaining its preparedness for immediate action at full speed would have been solved As it was, banked fires under the full installation required a heavy expenditure of fuel; coaling at sea off Santiago was often impossible, and the retirement of the ship to Santiago for that purpose meant her absence from a possible battle line."

High evaporative performances are now considered as essential in emergencies, involving the employment of forced draft, and Mr. Cathcart gives data and results of tests showing the manner in which the water-tube boiler responds to emergency demands of this sort.

"For full efficiency under forced draught a boiler should have sufficient furnace volume for complete combustion at the maximum rate of coal consumption to be attained; an area of heating surface adequate

when fully effective, to lower the temperature of the maximum weight of combustion gases thus produced to that of the normal temperature of the stack; and a system of baffling—either by tube walls or sheet-metal partitions—so designed as to make the whole area of the heating surface effective and to give the greatest possible travel to the gases in their passage from furnace to uptake, while not increasing unduly the draught resistance of the boiler.

"These are the ideal conditions for fully efficient forcing—conditions which the limitations of marine practice make difficult of fulfillment. It is true that large powers have been developed at low air pressures by the high forcing of boilers whose absence of baffling gave them slight draught resistance but the expenditure of fuel per boiler horse power is in such cases correspondingly large, since the gases take the shortest road to the uptake, the entire heating surface is not effective, and the stack temperature is abnormally high."

Mr. Cathcart's paper is an excellent presentation of the present status of the water-tube boiler in marine service, and as such it demands the attention of engineers both in the navy and in the merchant marine.

TECHNICAL WORK IN THE PAST AND PRESENT.

A REVIEW OF THE POSITION AND ACHIEVEMENTS OF THE ENGINEER AND TECHNOLOGIST FROM ANCIENT TIMES TO THE PRESENT.

W. v. Oechelhaeuser—Verein Deutscher Ingenieure.

AMONG the notable papers presented at the Berlin meeting of the Verein Deutscher Ingenieure we note the address of Herr von Oechelhaeuser, both because of its scholarly character, and because it treats of a phase of engineering to which we have made reference more than once of late, his work as an economist and director of human progress. Other eminent writers and speakers have perceived the importance of this phase of human effort, and the address of Reuleaux, "Kultur und Technik," delivered at Vienna more than twenty years ago, may be cited as noteworthy in this respect, but this latest discussion of a subject which can never grow old demands attention at the present time.

That the work of the engineer reaches back into the earliest recorded periods of history is fully understood, and later researches only confirm the work of the earlier investigators. This early engineering work is reviewed by Herr von Oechelhaueser at length, only to serve for comparison with the progress which has been made in modern times, especially in respect to the well-being of the workers themselves, indebted above all other men for the relief which has been given to them by the engineer.

Passing from ancient times, when massive engineering and architectural works were executed by the main strength of multitudes of workmen, and coming to the last century, the first in which the true development of mechanical technology began to be felt, we may note the extent to which mechanical appliances began to come to the relief of human physical effort.

Thus, in nearly every industry, the more difficult and laborious hand work has been replaced by that of machine tools, and in such work as cannot be wholly performed mechanically, the human portion has been limited to guidance and control, leaving the effort to be done by power. In like manner the mechanical forces of Nature have been placed under control, and improved motors of many kinds have been devised to place natural forces under the control of man. With this control of power there has come a far more efficient utilization of materials than formerly, besides which many by-products are employed to advantage which formerly went to waste. Especially noteworthy has been the improvement in quality and marvellous reduction in cost attained by mass production, involving the development of automatic machinery, repetitive processes, and scientific methods of remuneration of workmen according to their individual productivity.

With these advantages there has come also a greatly improved degree of precision in mechanical operations, a precision carrying with it all the advantages of inter-

changeability in the product, and a general elevation in the quality of the work of the individual.

Probably no benefit to mankind, due to the work of the engineer, has been greater than the development of facilities for rapid transport, both of himself and his goods from place to place, with a minimum expenditure of time. By this means alone one of the greatest obstacles to progress has been removed, the inability to bring the workman and the work together at moderate expenditure of time and money.

All of these elementary advantages unite to produce social and commercial developments impossible under earlier conditions. The substitution of mechanical for human energy has made possible the association of capital for the conduct of undertakings altogether impracticable to subdivided effort, while many results absolutely impossible to the unaided effort of man have been readily accomplished by the association of natural resources under human guidance.

An excellent example of what has been accomplished by the development of applied science is seen in Germany alone, when it is realised that the population of the empire has grown from 35 millions in 1850 to 60 millions in 1905, while the latter population is housed and fed and provided for, within the same area, in far greater comfort and happiness than was possible for the smaller number at the earlier date.

When to this evidence of progress there is added the fact that during this same period the German empire has added to its standing army from 800,000 to 900,000 men, drawn from productive service, and necessarily supported by the balance of the working population, it will be realized how effectively improved methods and appliances have added to the productive efforts, both of mechanics and agriculturists, or, as Herr von Oechelhaueser says: "given an increased motive power to the nation."

Herr von Oechelhaueser reviews in detail the improvements in technical methods and appliances which has thus so greatly increased the earning and productive capacity of the workman, including the development of automatic machinery, the introduction of milling cutters, of standard tools, improved motors, and the like. To these must be added the tremendous changes wrought by the commercial introduction of electricity for power, light, and communication, enabling the tool to be brought to the work, and the motive power to be delivered anywhere where a wire can be run. All of these, and many other improvements, have themselves created new industrial opportunities, the new appliances and methods requiring workshops for their manufacture, and creating commerce for their distribution, so that the growth has been like that of the snowball, increasing by the accretion of its own progress.

All these things we perceive have acted to increase the productiveness and wealth of a nation, but there is a further question to be asked: "What about the man?"

Has the development in applied science raised him to a higher plane of living, or has it acted to make him more and more of a machine himself?

Herr von Oechelhaueser protests strongly against the opinion which would make us believe that this material progress has been accomplished at the cost of a degradation of the worker from whose efforts the production must come. To him it clearly appears that the reaping machine has not debased the farmer, the sewing machine has not lowered the operative below the older hand worker, the machine tool degraded the mechanic. Surely the modern motorman, or the skilled chauffeur is higher in grade than the cabby, and the electrician in a superior class than the old-time lamplighter. In other departments of everyday life we may look for examples, and in so doing care should be taken to compare the present condition of life with that of the workers who formerly did the corresponding service, and few instances will be found in which the man has not been elevated with the progress which has been made in his work.

Turning to another side of material progress, Herr von Oechelhaueser shows how the power of modern capital is largely due to technical progress. Without the methods due to modern applied science neither the aggregations of capital necessary for modern undertakings could be provided, nor, when gathered, could they be utilised to advantage. With capital, and with mechanical appliances must come also modern technical education, enabling further progress to be made, in an ever widening field, not only in Germany, but throughout the world.

THE ENGINEERING INDEX

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The following pages form a **descriptive** index to the important articles of permanent value published currently in about two hundred of the leading engineering journals of the world—in English, French, German, Dutch, Italian, and Spanish, together with the published transactions of important engineering societies in the principal countries. It will be observed that each index note gives the following essential information about every publication:

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(4) Its length in words,
(5) Where published,
(6) When published,

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The full text of every article referred to in the Index, together with all illustrations, can usually be supplied by us. See the "Explanatory Note" at the end, where also the full titles of the principal journals indexed are given.

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CIVIL ENGINEERING

BRIDGES.

Arches.

Concrete Arch Bridge on the Queensland State Railways, Degilbo, Queensland. Illustrated description of a concrete arch of 80-ft. span across Deep Creek. 400 w. Eng News—July 19, 1906. No. 78065.

Concrete Arch on the Big Four at Danville. Illustrations taken during construction and after completion of this interesting reinforced concrete bridge, with information. 700 w. R R Gaz—July 13, 1906. No. 77946.

Thickness of the Key in Masonry Arches (Epaisseur à la Clef des Voutes en Maçonnerie). M. Davidesco. Deriving a new formula, adapted to arches of any form, for computing the thickness of the keystone. 2500 w. Ann d Ponts et Chaussées—1 Trimestre, 1906. No. 78136 E + F.

Bay of Fundy

Engulfing a Waterfall. Illustrated de-

We supply copies of these articles. See page 995.

scription of natural wonders at the Bay of Fundy, and two bridges crossing the St. John river at St. John, New Brunswick. 1400 w. Ry & Loc Engng—July, 1906. No. 77862 C.

Cantilever.

Cantilever Bridge of 1800 ft. Span Across the St. Lawrence. Illustrations, with brief description of details of the Quebec bridge. 450 w. Engng—July 6, 1906. No. 77981 A.

Drawbridges.

Replacing the Broadway Drawbridge with a New Span. Describes and illustrates interesting engineering methods used in transferring the old Broadway drawbridge over the Harlem ship canal to its new position, and the subsequent placing of the new span, made necessary to accommodate an extension of the Subway across the Harlem River. 700 w. Sci Am—June 30, 1906. No. 77709.

The Motive Power Arrangements of the New Railway Bridge over the North-Sea Canal at Velsen (Die Bewegungseinrichtungen des Neuen Eisenbahnbrücke über den Nordsee-Kanal bei Velsen). J. J. W. van Loenen-Martinet & F. C. Dufour. The bridge spans the Amsterdam-North Sea Canal for the railway between Haarlem and North Holland. The paper discusses the electric power arrangements for operating the large draw. 4000 w. Zeitsche d Ver Deutscher Ing—June 30, 1906. No. 78106 D.

Floors.

Tests of Metal Floors (Epreuves des Tabliers Métalliques). M. Garau. Data and results of tests of the floors of bridges on the railway between Quillan and Rivesaltes, in the French Pyrenees. 10000 w. 4 plates. Ann d Ponts et Chaussées—1 Trimestre, 1906. No. 78,-134 E + F.

Girders.

The Most Efficient Depth of Parallel Girders (Beitrag zur Theorie der Gunstigsten Trägerhohe des Parallelträgers). F. Gebauer. A mathematical examination of the strength of lattice girders, deriving formulas for the most efficient distance between chords. Three articles. 10000 w. Zeitschr d Oesterr Ing u Arch Ver—June 29, July 6, 13, 1906. No. 78159 each D.

Liege.

The Bridge of Commerce, Liège. Illustrated description of the new bridge over the river Meuse. 3000 w. Engr, Lond—July 20, 1906. No. 78315 A.

Model.

The Construction of a Bridge Model. Jarvis A. Marikle. Half-tones and description of a model of a portion of a double track cantilever bridge, at Pittsburg. 2000 w. Mach, N Y—July, 1906. No. 77700 C.

Reconstruction.

The Reconstruction of the Susquehanna River Bridge. An illustrated description of the methods used in replacing a single track bridge at Brown's, Pa., by a double-track plate-girder. The method of erection was novel and interesting, designed to suit the difficult conditions. 2500 w. Eng Rec—July 28, 1906. No. 78276.

Reinforced Concrete.

Jefferson Street Bridge, South Bend, Ind. Illustrates and describes a reinforced-concrete monumental arch bridge, having a total length of 554 ft. 4000 w. Eng Rec—July 28, 1906. No. 78273.

Reinforced Concrete Bridge on East Washington Street, Indianapolis, Ind. D. B. Luten. Illustrated description of an arch bridge reinforced wholly with smooth steel rods, and its method of construction. 1500 w. Munic Engng—July, 1906. No. 78036 C.

Strengthening.

The Strengthening of the La Canche Viaduct (Consolidation du Viaduc de la Canche). M. Lefebvre. Describing the manner in which an old masonry viaduct was strengthened by injecting liquid cement into the stone work. 3000 w. 1 Plate. Ann d Ponts et Chaussées—1 Trimestre, 1906. No. 78135 E + F.

Suspension.

Suspension Bridges and Arches (Ponts Suspendus et Ponts en Arc). E. Lebert. A comparison of the formulas of Godard and of Levy, considering suspension bridges and arches, each as an inversion of the other. 10000 w. Ann d Ponts et Chaussées—1 Trimestre, 1906. No. 78,-129 E + F.

Viaduct.

The Rondout Viaduct on the West Shore Railroad. Part elevations and plans with detailed description of the double-track structure recently built to replace a lighter superstructure. 2500 w. Eng Rec—July 14, 1906. No. 77939.

CONSTRUCTION.

Abattoir.

A Model Fireproof Abattoir. Illustrates and describes the fireproof and sanitary plant of the New York Butchers' Dressed Meat Co. 2000 w. Ins Engng—July, 1906. No. 78243 C.

A Model New Abattoir in New York City. Illustrated description of the new plant of the New York Butchers' Dressed Meat Co., located at Eleventh Ave. and 39th St., and the sanitary conditions adopted. 5000 w. Eng Rec—June 30, 1906. No. 77719.

Construction Features of a Model Abattoir. Illustrates and describes the design and construction of the buildings of the New York Butchers' Dressed Meat Co., in New York City. 3800 w. Eng Rec—July 7, 1906. No. 77834.

We supply copies of these articles. See page 995.

Model Municipal Slaughtering Establishment at Berlin—A Lesson in Sanitary Meat Dressing. William Mayner. Illustrations of the buildings, and description of the methods employed. 1600 w. Sci Am—July 28, 1906. No. 78269.

Power Plant of the New Abattoir in New York City. An illustrated detailed description of a 1600 h.p. boiler plant, with extensive coal storage facilities, an electric generating equipment of an aggregate capacity of 1000 kw. and refrigerating machinery with a total capacity of 250 tons of refrigeration per 24 hrs. 4000 w. Eng Rec—July 21, 1906. No. 78077.

Bins.

Investigations upon the Bottom and Lateral Pressures in Grain Storage Bins (Versuche zur Ermittlung der Boden und Seitenwanddrücke in Getreidesilos). J. Pleissner. Experimental determinations of the actual vertical and lateral pressures in bins of wood and of reinforced concrete. Two articles. 6000 w. Zeitschr d Ver Deutscher Ing—June 23, 30, 1906. No. 78104 each D.

Caisson Disease.

Investigations of the Effect on Man of High Air Pressures. Notes from a paper before the Royal Society, reporting the experiments and conclusions of Dr. Hill and Dr. M. Greenwood, Jr. 2200 w. Eng Rec—June 30, 1906. No. 77722.

Fireproof.

Developing Fireproof Architecture. George E. Walsh. Shows the effect of recent changes of building construction upon fireproof clay products, and the importance of furnishing good materials. 2500 w. Brick—July, 1906. No. 77901.

Foundations.

A Concrete Foundation. J. Mayne Baltimore. Illustrates and describes how one of the most dangerous rocks of the California coast was converted into a foundation for a lighthouse by the use of concrete. 600 w. Cement Age—July, 1906. No. 77861.

Footings in Foundations. Wilfrid Joseph Dilley. An investigation made to determine the slope for varying conditions. 1500 w. Inst of Civ Engrs—No. 3572. No. 78021 N.

The Foundation of the Myers Building, Albany. Illustrated description of methods used in reconstructing this department store, and the bracing and underpinning of adjacent buildings. 3300 w. Eng Rec—June 30, 1906. No. 77726.

Some Foundations for Buildings in Cleveland. Gen. J. A. Smith. Reviews successful past-foundation work in Cleveland and protests against the change to pile foundations for heavy buildings. General discussion. 14000 w. Jour Assn of Engng Soc—April, 1906. No. 78238 C.

Lighthouse.

The Construction of a Tower in Cement Concrete (La Construction d'une Tour en Béton de Ciment). M. Alexandre. Detailed description of the erection of a concrete lighthouse tower 64 metres high, at the mouth of the Gironde, France. 7500 w. 2 plates. Ann d Ponts et Chaussées—1 Trimestre, 1906. No. 78128 E + F.

Office Buildings.

Reinforced Concrete Bank and Office Building, Los Angeles, Cal. Max J. Welch. Illustrates this recently completed building, discussing the engineering details of the construction. 1000 w. Eng News—July 5, 1906. No. 77821.

The Design, Installation and Maintenance of the Modern Office Building. Charles Gobrecht Darrach. A review of the design, construction and of the mechanical installations required to meet the necessities of these business centers. Ills. 6000 w. Jour Fr Inst—July, 1906. No. 78010 D.

The United States Express Co.'s Building, New York City. Illustrated detailed description of a 22-story, basement and cellar building on Rector & Greenwich Sts., New York City. Especial care was given to the provisions for wind pressure. 3000 w. Eng Rec—July 28, 1906. No. 78277.

Piles.

Concrete as Piling. Frank B. Gilbreth. Read at meeting of Am. Portland Cement Mfrs. Illustrated description of the making and driving of corrugated concrete piles. 1600 w. Cement Age—July, 1906. No. 77860.

Reinforced Concrete.

Ferro Concrete. H. Kestner. Read at meeting of the Inst. of Mech. Engrs., Johannesburg. Discusses the qualities which give this material advantages as compared with ordinary constructions, and the precautions necessary to secure satisfactory results. 5000 w. Archt, Lond—June 22, 1906. No. 77772 A.

Reinforced Concrete in the New San Francisco Building Law. Gives the portions of the new building law relating to buildings with self-supporting walls and metal frames carrying the floors only. 1800 w. Eng News—July 26, 1906. No. 78235.

Results of Plain and Reinforced Concrete Column Tests at Watertown Arsenal. James E. Howard. Read at meeting of the Am. Soc. for Test. Mat. Diagrams, and discussion of certain features of tests in progress, tending to show that high ultimate strength may be reached by each of the three methods considered. 1600 w. Eng News—July 5, 1906. No. 77823.

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The Adhesion of Concrete to Steel. Editorial on the investigations and results for the purpose of ascertaining values of the adhesion between concrete and embedded bars of iron and steel. 1700 w. Builder—June 30, 1906. No. 77872 A.

The Comparative Advantages of Hard and Soft Steel for Reinforced Concrete. Daniel B. Luten. Presents the arguments given by both sides and concludes that neither presents any marked advantage over the other for reinforcement. 2300 w. Eng News—July 19, 1906. No. 78068.

The Design of Reinforced Concrete Columns and Footings. Edward Godfrey. Supplementing an earlier paper on the "Design of Reinforced Concrete Beams and Slabs." 3000 w. Eng News—July 12, 1906. No. 77925.

The Determination of the Best Proportions for Reinforced-Concrete Beams (Die Bestimmung der Wirtschaftlich Günstigsten Abmessungen von Eisenbetonbalken). R. Saliger. An examination of beams, reinforced for tension and for compression stresses, with tables for practical computation. 4000 w. Oesterr Wochenschr f d Oeffent Baudienst—July 7, 1906. No. 78161 D.

See Also Civil Engineering, Bridges.

Retaining Walls.

Masonry Retaining Walls (Murs de Sontènement en Maçonnerie). F. Chaudy. Describing a peculiar form of retaining wall, with spurs or projections of reinforced concrete extending back into the earth behind. 2000 w. Mem Soc Ing Civ de France—March, 1906. No. 78138 G.

Roads.

Experiments with Tar and Oil for Roads at Jackson, Tenn. Describes methods used and excellent results obtained with tar, giving the cost. Also the results obtained with oils and the cost. 2800 w. Eng Rec—June 30, 1906. No. 77725.

Roofs.

A Practical Talk on Roofing. Discusses how to put on good tin roofs, the conditions, workmanship, etc. Ills. 2800 w. Met Work—July 14, 1906. No. 77902.

The Charing Cross Roof. Remarks about the cause of the accident as given in the report of Major J. W. Pringle. 2200 w. Archt, Lond—June 22, 1906. No. 77773 A.

The Disaster at Charing Cross Railway Station. A review of Major Pringle's report to the Board of Trade concerning the fall of roof and its causes. Ills. 2200 w. Ir & Coal Trds Rev—June 22, 1906. No. 77791 A.

Steel Details.

Some Steel Details in the Wanamaker Building, New York. Outline description of this building, with special notes on the framing. 1200 w. Eng Rec—June 30, 1906. No. 77721.

Tunnels.

Construction Difficulties with the Bosruck Tunnel (Die Bauschweirigkeiten beim Bosrucktunnel), M. J. Blodnig. A general illustrated account of the work on the tunnel under the Bosruck from Ardning to Emiliendorf, in the Styrian Alps. 3500 w. Zeitschr d Oesterr Ing u Arch Ver—June 22, 1906. No. 78158 D.

Lowering the Tunnels Under the Chicago River. Concerning the lowering of the three street railway tunnels under the Chicago River, and the methods proposed. Editorial explaining the necessity of the work and the advantages to be gained. 2000 w. Eng Rec—July 21, 1906. No. 78078.

Single and Double Track Alpine Tunnels (Einspurige und Zweispurige Alpentunnel). Prof. Hennings. Describing a plan for boring a double track tunnel, with a small tunnel beneath for construction and ventilation. 1800 w. Schweiz Bauzeitung—June 16, 1906. No. 78141 B.

The Construction of the East River Division of the Pennsylvania, New York and Long Island Railroad Company's Tunnels. Begins a full account of the work as it now stands, the difficulties met, etc. Also editorial. Ills. 4800 w. Eng Rec—July 14, 1906. Serial. 1st part. No. 77934.

The East River Tunnels for the New York City Terminus of the Pennsylvania and Long Island Railroads. Describes interesting features of the construction work. 2300 w. Eng Rec—July 7, 1906. No. 77836.

The Pennsylvania Tunnels Under the East River. A brief description of the methods employed in driving the tunnels and the working plant of the contractors. Ills. 7000 w. R R Gaz—July 6, 1906. Serial. 1st part. No. 77813.

The Simplon Tunnel (Le Tunnel du Simplon). E. Lemaire. A well illustrated account of the design and execution of the Simplon tunnel, and a comparison of its facilities with those of the other Alpine tunnels. Two articles, 7500 w. 1 plate. Génie Civil—June 23, 30, 1906. No. 78122 each D.

The Simplon Tunnel (Per l'Apertura del Sempione). Gustavo Coen. A review of the new commercial routes rendered available by the completion of the new route through the Alps. Two articles, 12,000 w. Rivista Marittima—April, May, 1906. No. 78185 each H.

The Tunnel Work of the Pennsylvania Railroad Under the East River. Concerning the construction of the two twin-tube shield-driven tunnels, the compressed air work, shaft construction, shield construction, etc. 3800 w. Eng News—July 12, 1906. No. 77929.

Tunneling by the Freezing Method Under the East River. An account of an experiment in progress by the Pennsylvania R. R. with a new system of freezing the moist material so that no air pressure will be require. 1600 w. Sci Am—July 14, 1906. No. 77930.

Working of the Simplon Tunnel. Notes on the tunnel and its approach lines, the ventilation, temperature, etc. 1500 w. Engr, Lond—June 22, 1906. No. 77797 A.

Underpinning.

Underpinning a Tall Brewery Wall on Rock Foundations. A brewery on Park Ave., New York City, jeopardized by the terminal improvements of the N. Y. C. & H. R. R. R., is described and the method of underpinning explained and illustrated. 1800 w. Eng Rec—July 7, 1906. No. 77839.

Underpinning the Grand Central Palace, New York. Illustrated description of methods used in underpinning a heavy wall of old-fashioned construction in connection with the construction work of the depressed yards of the N. Y. C. & H. R. R. R. Also editorial. 2800 w. Eng Rec—June 30, 1906. No. 77723.

MATERIALS OF CONSTRUCTION.

Asphalt.

The Proximate Composition and Physical Structure of Trinidad Asphalt. Clifford Richardson. Reports investigations carried out to determine the character of the substances which make up the portion of refined asphalt hitherto regarded as "organic matter not bitumen." 3500 w. Eng Rec—June 30, 1906. No. 77727.

Brick.

A Large Shale Brick Factory in Eastern Illinois. Illustrates and describes a plant at Danville, Ill., which has a capacity of producing 200,000 bricks a day. 3000 w. Eng Rec—July 7, 1906. No. 77838.

New Sand-Lime Brick Plant at South River, N. J. A plant for the manufacture of sand-lime brick under the Huennekes system is illustrated and described. 2700 w. Eng Rec—July 14, 1906. No. 77938.

Building Stones.

Tests of Building Stones. Valuable data on the fire resistance of natural building stones found in New York State. Ills. 3300 w. Ins Engng—July, 1906. No. 78245 C.

Cement.

A Talk on Cement. An article based on an account by P. Gillespie, in the report of the Bureau of Mines of Ontario, Vol XIV. Its chemical composition and uses are discussed in the present number. 1200 w. Can Archt—June, 1906. Serial. 1st part. No. 77714 C.

Cement Testing Laboratory, Philadelphia Rapid Transit Company. Gives the specifications for Portland cement as adopted, and describes the tests, and other work done in the laboratory. 2200 w. Ry Age—July 27, 1906. No. 78290.

The Manufacture of Portland Cement. On the processes of cement-making as carried on at the Northfleet Works of the Associated Portland Cement-Manufacturers, Limited. Ills. 4000 w. Engng—July 20, 1906. No. 78308 A.

Concrete.

Proportioning Concrete. Sanford E. Thompson. Considers methods of proportioning materials and for comparisons of quality, and the effect of different characters of aggregate. General discussion. 5800 w. Jour Assn of Engng Socs—April, 1906. No. 78239 C.

The Action of Sea Water Upon Concrete. J. Watt Sandeman. Discusses proposed standard proportions for impervious concrete, giving tables estimating cost, etc. 1400 w. Sci Am Sup—June 30, 1906. No. 77711.

The Puddling Effect of Water Flowing Through Concrete. William Ralph Baldwin-Wiseman. Gives results of experiments on the rate of flow of water through a specimen of concrete, identical in composition with that used in the construction of the new graving-rock at Southampton. 1200 w. Inst of Civ Engrs—No. 3574. No. 78022 N.

Laboratory.

The Underwriters' Laboratory Plant in Chicago. Illustrated detailed description of this building which is devoted exclusively to experimental work in fire protection engineering. 2700 w. Eng Rec—July 7, 1906. No. 77833.

Protective Coatings.

Protective Coatings for Iron and Steel. Arthur B. Harrison. Read before the Am. Soc. for Test. Mat. Reviews the opinions of those who have made a study of this subject, and reports experiments and results. Favors the use of carbon coatings which dry by evaporation. 3000 w. Eng Rec—July 7, 1906. No. 77835.

Testing.

Influence of the Temperature of Water upon Test Pieces (Influence de la Temperature de l'Eau sur les Eprouvettes). M. Mercier. Data and results of investigations upon the influence of the temperature of the water on cement and mortar briquettes. 2500 w. Ann d Ponts et Chausseés—I Trimestre, 1906. No. 78132 E & F.

Tension-Tests of Steel Angles with Various Types of End-Connection. Frank P. McKibben. Read before the Am. Soc.

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for Test. Mat. An account of tests made in the testing laboratory of the Mass. Inst. of Technology upon 27 specimens of rolled steel angles such as are used in structural work. 1200 w. Eng News—July 5, 1906. No. 77820.

The Sand Blast for Testing Materials. H. Burchartz. Illustrates and describes the apparatus used in applying the sand blast to the testing of materials for building, paving, etc. 1200 w. Eng Rec—July 14, 1906. No. 77936.

MEASUREMENT.

Photogrammetry.

The Use of Tentative Photography in the German Navy for Exploration Work (Sur Plusieurs Tentatives Poursuivres dans la Marine Allemande pour Utiliser la Photographie dans les Voyages d'Exploration). A. Laussedat. A discussion of the work of Laas, in measuring ocean waves on the Preussen, comparing the method of intersections with the method of parallaxes. 2500 w. Comptes Rendus—June 11, 1906. No. 78124 D.

Seismographs.

Earthquake Records and Their Interpretation. Gives an actual record of an earthquake showing some of the irregularities, with explanation. 2000 w. Engng—June 29, 1906. No. 77891 A.

Seismograph and Magnetograph Records of the San Francisco Earthquake, April 18, 1906. Dr. L. A. Bauer. A study of seismograph and magnetograph records, and of why an earthquake will at times be recorded by magnetic instruments, and at other times leave no record. 4000 w. Pop Sci M—Aug, 1906. No. 78257 C.

The Investigation of the San Francisco Earthquake. G. K. Gilbert. An illustrated sketch of the physical features of the California earthquake, with explanation of the causes. 5000 w. Pop Sci M—Aug, 1906. No. 78256 C.

Surveying.

Azimuth Circles with Microscopes for Surveying Work (Cercle Azimutal du Service Technique du Cadastre). Ch. Lallemand. Describing an improved type of theodolite of a high degree of precision, with tests by the Ponts et Chaussées. 1000 w. Comptes Rendus—June 5, 1906. No. 78127 D.

Surveying Without Instruments. A. L. de Leeuw. Explains how work of sufficient accuracy for many cases may be done without the ordinary surveyor's instruments. Gives examples. 2000 w. Mach, N Y—July, 1906. No. 77703 C.

MUNICIPAL.

Dust.

The Suppression of Dust on Roads by Oil Sprinkling. An account of method, cost, etc., of this treatment of streets and roads as carried out at North Sydney, N. S. W. 1500 w. Engng—July 13, 1906. No. 78218 A.

Fire Protection.

Fire Protection in Cities. S. H. Lockett. Discussing the development of water-works systems and public fire departments in American cities. 6000 w. Ins Engng—July, 1906. No. 78244 C.

Parks.

The Preservation of Open Spaces in Large Cities (La Conservation des Espaces Libres dans les Grandes Villes). A. Bidault des Chaumes. A discussion of the importance of municipal parks, with illustrations from Paris, London, Berlin, and other cities. 3000 w. Génie Civil—June 16, 1906. No. 78121 D.

Sanitation.

Experimental Methods as Applied to Water and Sewage-Works for Large Communities. George W. Fuller. One of several papers prepared in commemoration of the twenty-fifth anniversary of the doctorate of Prof. William T. Sedgwick. Discusses sanitary science, the new conditions, and methods being tried to meet their requirements. 6000 w. Eng Rec—July 21, 1906. No. 78079.

Sanitary Science and the Public Health. Leonard P. Kinnicutt. Commencement lecture. Especially considering modern methods of sewage disposal. Ills. 4000 w. Jour Worcester Poly Inst—July, 1906. No. 78004 C.

Sewage.

Report of the Board of Advisory Engineers of the Sewerage Commission of Baltimore. A report of the conclusions reached in regard to the problem of sewage treatment with the object of obtaining "the highest practicable degree of purity." 6000 w. Map. Eng Rec—July 28, 1906. Serial. 1st part. No. 78275.

The Operation of Sewerage Works. A number of papers by different writers, reporting the systems in use at various places, mostly isolated plants for schools, colleges, sanatoriums, etc. Ills. 5800 w. Jour Assn of Engng Socs—April, 1906. No. 78237 C.

The Purification of Sewage and Industrial Wastes (Epuration des Eaux d'Egout et des Eaux industrielles). B. Bezault. A review of the bacterial process of sewage purification, with examples from British and French installations. 10,000 w. Bull Soc d'Encour—May 31, 1906. No. 78174 G.

The Purification of Waste Water (Epuration des Eaux Usées). M. Michel. An exhaustive review, historical and technical of the development of modern methods of sewage purification, with especial reference to bacterial processes in France. Serial, Part I. 15,000 w. Ann d Ponts et Chaussées—I Trimestre, 1906. No. 78130 £ + F.

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Sewers.

Practical Sewerage. Alberto F. Schreiner. A general description of the method of designing sewerage systems and the method of construction of sewers used in the Bureau of Sewers of the Borough of Queens, New York City. 3000 w. Trans Assn of Civ Engrs of Cornell Univ—1906. No. 78038 G.

Streets.

Adjourned Discussion on Mr. Waterhouse's Paper: "Some Observations on the Report of the Royal Commission on London Traffic, with Special Reference to the Proposed Formation of New Thoroughfares." 10500 w. Jour Roy Inst of British Archts—June 16, 1906. No. 77840 C.

An Important Street Improvement with Street Railway Subway at London, England. Cross-sections and description of a broad thoroughfare running north from the Strand; and of the shallow subway for double-truck cars. 2000 w. Eng News—July 12, 1906. No. 77927.

Street Extensions in Queens Borough, New York City. Albert H. Chandler. An account of the work of the Topographical Bureau, their methods, etc. 4200 w. Trans Assn of Civ Engrs of Cornell Univ—1906. No. 78039 G.

WATER SUPPLY.

Air-Lift.

On the Raising of Water by Compressed Air, at Preesall, Lancashire. James Kelly. Describes experiments carried out at works requiring 800,000 gallons of water every 24 hours. 5000 w. Inst of Civ Engrs—No. 3573. No. 78025 N.

Boring.

The Deep Well and Boring at Lincoln. An account of the deepest boring in the United Kingdom, and the great find of water. Also editorial. 2500 w. Jour Gas Lgt—June 19, 1906. No. 77774 A.

Boston.

The Water Supply of Boston. An illustrated review of the history of water supply for Boston, Mass., dating back to 1652. 2000 w. Fire & Water—July 7, 1906. No. 77800.

Cincinnati.

Water Famine and Typhoid in Cincinnati. Ward Baldwin. An explanation of the causes of the so-called "water famine" which occurred in certain parts of Cincinnati during the week June 3, to 10 of this year. Maps. 2000 w. Eng News—July 5, 1906. No. 77819.

Filtration.

Springfield's New Filters. Elbert E. Lockridge. Describes sand variety filters for clarifying water highly polluted with anabaena, and gives an account of the difficulties overcome. 2700 w. Munic Jour & Engr—July 4, 1906. No. 77805 C.

The Sand Filtration of Potable Water (La Filtration sur Sable des Eaux Potables). A. Bidault des Chaumes. A description of the Puech system of sedimentation as installed at Nanterre, Mont Valerien, for the supply of the suburbs of Paris. 2500 w. 1 plate. Génie Civil—May 26, 1906. No. 78117 D.

Gates.

The Balanced Gates at the Crotoy Reservoir (Vannes Equilibrées du Crotoy). M. Chevallier. Describing the installation of balanced gates of the Stoney type in the regulating reservoirs of the Somme. 2500 w. 1 plate. Ann d Ponts et Chaussees—I Trimestre, 1906. No. 78137 E + F.

Ontario.

The Water-Works of St. Catharines. Alexander Milne. An illustrated descriptive and historical review of the supply for this city, near Niagara Falls. 2000 w. Fire & Water—July 7, 1906. No. 77802.

Pumping.

The Growth of the Pumping Station. Charles A. Hague. Read before the Am. Water-Works Assn. A review of the growth and development of pumping stations, and the tendency for future construction and operation. 7000 w. Eng Rec—July 14, 1906. No. 77940.

Purification.

Disinfection as a Means of Water Purification. George C. Whipple. Read before the Am. Water-Wks. Assn. Calls attention to the need of more thorough study of this subject, and describes the water-works of Ostende and Middelkerke, Belgium, where chlorine is used as a disinfecting adjunct to filtration. 4000 w. Eng Rec—July 28, 1906. No. 78274.

Reclamation.

The United States Reclamation Service. An explanation of the methods of carrying on the work of irrigation in the western part of the United States. 2300 w. Engr, Lond—July 6, 1906. No. 77988 A.

Regulations.

Regulations Governing the Submission of Water Supply Projects for the Approval of the Prussian Government. Translated by William Paul Gerhard. A copy of a circular published by the Prussian Minister for Education and Sanitary Matters. 2200 w. Eng News—July 19, 1906. No. 78066.

Reservoirs.

The Emptying of Systems of Reservoirs (Le Vidage des Systèmes de Réservoirs). Edmond Maillet. A mathematical study of the time required to empty reservoirs situated at various levels and with communicating pipes in different positions. Formulas are derived for the more general cases. 9000 w. Ann d Ponts et Chaussées—1 Trimestre, 1906. No. 78131 E + F.

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WATERWAYS AND HARBORS.

Canal Lifts.

Elevators for Canal Boats (Ueber Schiffshebewerke). Dr. A. Riedler. A comparison of the inclined plane and the revolving drum design as submitted in the competition for the Danube-Oder canal, at Prerau. Serial, Part I. 3500 w. Zeitschr d Oesterr Ing u Arch Ver—July 13, 1906. No. 78160 D.

Canals.

An Underflow Canal Used for Irrigation at Ogalalla, Nebraska. Charles S. Slichter. Describes one of the most successful underflow canals, discussing the causes of failure of this method of irrigation. Ills. 2200 w. Eng News—July 5, 1906. No. 77817.

On Waterways in Great Britain. John Arthus Saner. Considers the present condition of the waterways and the measures necessary for their improvement. Tabulated information is given in appendixes, also discussion. Maps. 50000 w. Inst of Civ Engrs, No. 3593—Nov. 14, 1905. No. 78017 N.

Docks.

Lowering the Sill of the Great Central Railway Union Dock, Grimsby. An illustrated description of the methods adopted, which allowed shipping to pass in and out of the dock. 2000 w. Engng—July 20, 1906. No. 78311 A.

The Chalmette Docks of the New Orleans Terminal Co. Illustrated description of this immense deep-water railroad and ship terminal on the Mississippi River at New Orleans. 5000 w. Eng Rec—July 28, 1906. Serial. 1st part. Also editorial. No. 78272.

Dredging.

A New Dredging Vessel for India. Illustrated description of the suction-pump canal embanking dredger Foyers, built for the government of India. 800 w. Marine Rev—July 12, 1906. No. 77952.

Dredging Plant for India. Illustrated detailed description of a large and notable dredging vessel for special work in the Bengal Presidency. It is a suction-pump, triple-screw, canal embankment dredger designed especially for opening new waterways, and improving shallow canals and rivers. 1200 w. Engr, Lond—July 13, 1906. No. 78222 A.

Harbors.

The Port of San Pedro. An illustrated account of the development of this port of southern California, with explanation of the causes that have effected its improvement. 2200 w. Marine Rev—July 26, 1906. No. 78271.

Lock.

The Construction of a Second Tide Lock in the Merwede Canal at Utrecht (Over den Bouw eener Tweede Schutsluis in het Merwede Kanael bewesten Utrecht). A. E. Kempees. With plans of the lock and details of the foundations and photographs of construction work. 2500 w. De Ingenieur—July 7, 1906. No. 78182 D.

Pier.

Reconstruction of the Atlantic City "Steel Pier" in Reinforced Concrete. An illustrated article describing the plan of construction, and rebuilding. 2500 w. Eng News—July 26, 1906. No. 78233.

Storage and Shipment of Iron Ore at Almeria. John Ernest Harrison. An illustrated description of the Alquife Co.'s pier in the south of Spain, and the appliances for the shipment of hematite ore. 3300 w. Inst of Civ Engrs—No. 3564. No. 78020 N.

River Regulation.

Regulating Dams for the San Juan and Mendoza, Argentina (Diques Niveladores de San Juan y Mendoza). Oreste Vulpiani. A report to the government, showing the importance of rebuilding the regulating dam on the San Juan, in a manner similar to that already done on the Mendoza. 4000 w. La Ingenieria—May 15, 1906. No. 78183 D.

Thames.

The Thames Conservancy. Describing the work of improving and deepening the navigable channel which is in progress and proposed. 1700 w. Engr, Lond—July 20, 1906. Serial. 1st part. No. 78318 A.

ELECTRICAL ENGINEERING

COMMUNICATION.

Cables.

Submarine Cables. H. C. Specht. Describes the construction, laying and repair of a modern submarine cable. Ills. Discussion. 4000 w. Pro Engrs' Soc of W Penn—July, 1906. No. 78246 D.

Space Telegraphy.

A Note on the Theory of Directive Antennæ or Unsymmetrical Hertzian Oscillators. J. A. Fleming. Read before the Royal Soc. Gives a mathematical explanation of the fact that a bent oscillator radiates more in the direction opposite

to that in which the free ends point than it does in the other direction. 1700 w. Elect'n, Lond—July 6, 1906. No. 77971 A.

Interference in Wireless Telegraphy and the International Telegraph Conference. R. A. Fessenden. Deals with the subject of selective receptions of wireless telegraph messages. 2200 w. Elec Rev, Lond—July 6, 1906. Serial. 1st part. No. 77969 A.

Wanted: A Synthetic Wireless. B. T. Walling. Discusses the present outlook for a satisfactory synthetic system, giving a report of tests made at Culebra, and considering some effects of synthesis. 3500 w. Pro U S Nav Inst—June, 1906. No. 78031 G.

Wireless Telegraphy. H. M. Hozier. A sketch of the position of wireless telegraphy in the United Kingdom, and the movement to place it under government control. Also briefly considers its development in other countries, and applications which may possibly be made. 3000 w. Nineteenth Cent—July, 1906. No. 78002 D.

Telegraphy.

A Theoretical Study of Electric Circuits for Telegraphic Purposes (Theoretische Beschonwingen over Stroomketens voor Telegraphische Doellinden). J. C. D. M. de Roos. An exhaustive mathematical study of the most efficient current pressures for telegraphy. 30000 w. Tijdschr van het Kljk Inst van Ing—Feb. 3, 1906. No. 78186 H.

Telegraphy and Wireless Telegraphy During the San Francisco Disaster. W. R. Carroll. A brief account of the service rendered by the wireless system. 1200 w. Sci Am—July 28, 1906. No. 78268.

Telephony.

The Telephone in Railroad Service. H. L. Burdick and W. T. Saunders. General remarks on the growing use of the telephone in railway operation, with a description of the development on the Burlington system. Ills. 2800 w. Ry Age—July 20, 1900. No. 78094.

The Telephone Question of the Immediate Future (Telephonfrage der Nächsten Zukunft). Karl v. Barth. A review of the rapid development in the use of the telephone, with illustrations of some of the latest large exchanges in Europe. Two articles. 7000 w. Electrotech u Maschinebau—July 1, 8, 1906. No. 78171 each D.

Transformer Efficiency of Telephonic Induction Coils, as Related to Long Distance Transmission. D. McL. Therrell. Describes an arrangement of circuits claimed to be particularly advantageous over long-distance aerial, telephone circuits. 2000 w. Elec Wld—June 30, 1906. No. 77758.

DISTRIBUTION.

Cables.

Constants for Calculating the Heating of Cables (Die Material Konstanten zur Berechnung der Kabel auf Erwarmung). J. Teichmuller und P. Humann. Deriving a formula for computing the increase in temperature of cables with especial reference to the empirical constants for various materials. 6000 w. Elektrotech Zeitschr—June 21, 1906. No. 78162 B.

The Laying of a 10000-Volt Cable. Dr. Alfred Gradenwitz. An illustrated article showing the recent operation of laying a 10000-volt cable in Germany. 700 w. Sci Am—June 30, 1906. No. 77708.

Conduits.

Electrolier and Conduit Hangers. Thomas W. Poppe. Discusses matters relating to conduit work in dwellings, giving diagrams. 900 w. Elec Wld—July 7, 1906. No. 77871.

Wiring.

Points on Central Station Wiring. W. Barnes, Jr. Considers the importance of wiring, methods of tinning terminals and cables, location of cables, conduits, etc. Ills. 1500 w. Elec Jour—July, 1906. No. 78034.

ELECTRO-CHEMISTRY.

Accumulators.

Chemical and Physical Reactions of the Nickel Oxide Electrode in the Alkaline Accumulator (Ueber das Chemische und Physikalische Verhalten der Nickel-Oxyd-Elektrode im Jungner-Edison-Akkumulator). Julian Zedner. Data and results of experimental investigations in the laboratory of the university of Göttingen. 5000 w. Zeischr für Elektrochemie—July 6 1906. No. 78172 D.

The Alkaline Accumulator (Der Alkalische Akkumulator). Dr. Max Roloff. A study of the chemical reactions in the Edison alkaline storage battery. 4000 w. Elektroteck u Maschinenbau—June 17, 1906. No. 78169 D.

The Lines of Current in Storage Batteries—An Experimental Study. M. U. Schoop. Describes a method which permits studying, with relatively simple means, the distribution of the lines of current in electrolytes with sufficient exactness for all practical purposes. 3000 w. Elec-Chem & Met Ind—July, 1906. Serial. 1st part. No. 77918 C.

Colloids.

Colloids and Their Utilization. An explanation of the term, with some of the technical applications of colloids. 3800 w. Engng—July 6, 1906. No. 77978 A.

Electric Smelting.

Electric Smelting of Iron Ore. Abstract of Dr. Eugene Haanel's official preliminary report on the experiments made at Sault Ste. Marie, Ont. 3800 w. Elec-Chem & Met Ind—July, 1906. No. 77917 C.

We supply copies of these articles. See page 995.

Electric Smelting of Iron Ore. Phillips Thompson. Remarks on the results obtained by Dr. Eugene Haanel in the Sault Ste. Marie experiments. 1600 w. Eng & Min Jour—July 7, 1906. No. 77846.

Electrolysis.

Electrolysis of Dilute Solutions of Acids and Alkalis at Low Potentials: Dissolving of Platinum at the Anode by a Direct Current. George Senter. Read before the Faraday Soc. A report of experimental investigations, with conclusions. 3500 w. Elect'n Lond—July 20, 1906. No. 78298 A.

Electrometallurgy.

Electrometallurgy in 1905. John B. C. Kershaw. A review of the year's progress in the electrometallurgical industries. 1400 w. Eng & Min Jour—July 28, 1906. No. 78279.

The Electrolytic Deposition of Zinc Using Rotating Electrodes. T. Slater Price and G. H. B. Judge. Read before the Faraday Soc. A summary of the results thus far obtained in an investigation of the deposition of zinc from solutions of zinc sulphate, making use of a rotating cathode. 2000 w. Elect'n, Lond—July 6, 1906. No. 77970 A.

Furnaces.

An Electric Furnace for Heating Crucibles. Oliver P. Watts. Illustrates and describes a type of experimental furnace used in melting on a considerable scale moderately refractory metals, such as iron, and chromium. 2000 w. Elec-Chem & Met Ind—July, 1906. No. 77919 C.

Vertical Arc Furnaces for the Laboratory. Samuel A. Tucker. Gives plan and elevation of an arc furnace consisting essentially of a Moissan furnace of graphite, arranged vertically. 900 w. Elec Chem & Met Ind—July, 1906. No. 77916 C.

Nitrogen.

Artificial Production of Nitrate of Lime by Electric Discharge. John B. C. Kershaw. Remarks on the processes of different experimenters, giving a brief illustrated description of the method of Messrs. Birkeland and Eyde. 1500 w. Elec Wld—July 21, 1906. No. 78204.

On the Oxidation of Atmospheric Nitrogen in Electric Arcs. K. Birkeland. Read before the Faraday Soc. On the progress recently made with regard to the oxidation of atmospheric nitrogen, indicating its possible future advances, and describing the Birkeland-Eyde process. Ills. 2500 w. Elec Engr, Lond—July 6, 1906. Serial. 1st part. No. 77968 A.

The Electro-Chemical Problem of the Fixation of Nitrogen. Prof. Philippe A. Guye. Read before the Soc. of Chem. Ind. Slightly condensed. Deals especially with the commercial side of the question. 3000 w. Elect'n, Lond—July 13, 1906. Serial. 1st part. No. 78206 A.

Slags.

A New Apparatus to Determine the Melting Points of Slags. Woolsey McA. Johnson. Illustrated description of the apparatus and its use. 700 w. Elec-Chem & Met Ind—July, 1906. No. 77915 C.

ELECTRO-PHYSICS.

Earth Currents.

Report of the Commission of the German Gas and Water Companies for the Investigation of Earth Currents. Gives results of recent work. 1300 w. Elect'n, Lond—July 20, 1906. No. 78297 A.

Induction.

Effects of Self-Induction in an Iron Cylinder. Ernest Wilson. Read before the Royal Soc. An examination of what goes on in an iron cylinder when electric currents are reversed in it, and maintained steady after reversal. 1600 w. Elect'n, Lond—July 20, 1906. No. 78299 A.

Laboratory.

The National Physical Laboratory, Bushey House. Illustrated description of the new electrotechnical building, with an account of the newer work of the laboratory and its recent developments, especially in electrical matters. 1100 w. Elec Rev, Lond—June 22, 1906. Serial. 1st part. No. 77779 A.

Magnets.

Polyphase Magnets. D. L. Lindquist. Gives an outline of the features which should be embodied in the construction of polyphase magnets. 1000 w. Elec Wld—July 21, 1906. No. 78205.

Oscillations.

The Influence of the Armature Slots upon the Oscillations of Alternators (Ueber die Entstehung und Form von Oberschwingungen durch die Zähne der Wechselstromdynamos). Dr. K. Simons. An examination of the form and phase of the excess oscillations taken in connection with the relation of the armature slots to the poles. 1800 w. Elektrotech Zeitschr—July 5, 1906. No. 78167 B.

Resistivity.

The Resistivity Temperature-Coefficient of Copper. Dr. A. E. Kennelly. Shows a short and simple computation made with the aid of a given table. 400 w. Elec Wld—June 30, 1906. No. 77757.

GENERATING STATIONS.

Alternators.

A 120,000-Period Alternator. Emile Guarini. Illustrated description of this high-frequency alternator, showing some of the difficulties encountered in its construction. 1500 w. Sci Am Sup—July 7, 1906. No. 77830.

Heat Tests on Alternators. Sebastian Senstius. Gives a series of methods developed as substitutes for full-load heat-tests. 2500 w. Pro Am Inst of Elec Engrs—June, 1906. No. 78042 D.

We supply copies of these articles. See page 995.

"Image Current" Alternators. G. Faccioli. A description of an alternator excited by low frequency currents whose armature reaction is compensated by image or reflected currents flowing internally in the machine. Also editorial. Ills. 2500 w. Elec Wld—July 14, 1906. No. 77962.

The Self-Synchronizing of Alternators. Morgan Brooks and M. K. Akers. Explains a method of using coreless inductances for safe synchronizing of alternators. 2000 w. Pro Am Inst of Elec Engrs—June, 1906. No. 78047 D.

Armatures.

Series-Parallel Armatures with Equipotential Connections (Reihenparallelanker mit Alquipotential verbindungen). E. Arnold. With computations for the windings, and tables to aid in determining the connections. 6000 w. Electrotech Zeitschr—July 5, 1906. No. 78166 B.

The Estimation of the Temperature Rise of Armatures. A. Press. Showing the necessity for taking into account sparking at the commutator, as well as the relations between the commutator and armature losses. 500 w. Elec Wld—June 30, 1906. No. 77754.

Baltimore.

Steam Turbine Station of Baltimore Electric Power Company. J. R. Bibbins. Illustrated description of the Gould St. Station and its equipment. 2200 w. Elec Wld—July 14, 1906. No. 77959.

Central Stations.

Modern Central Stations. Frank C. Perkins. This first of a series of illustrated articles describes the gas engine plants at Münster, in Westphalia, and Zeitz, Germany. 1500 w. Cent Sta—July, 1906. Serial. 1st part. No. 77859.

Commutators.

Construction of Commutators for Dynamos. A. G. Ellis. An illustrated article tracing the building of the commutator, beginning with the raw material and ending with the finished commutator. 1200 w. Mech Engr—July 21, 1906. Serial. 1st part. No. 78302 A.

Dynamos.

High-Speed and High-Voltage Continuous-Current Dynamos. H. M. Hobart. Describes a study made by the writer for a 1000 kw. 1000 volt 1000 revs. per min. continuous-current dynamo. 1700 w. Elect'n, Lond—June 29, 1906. No. 77888 A.

Efficiency.

Relative Economies of Electrical Supply from Small Local Stations and from Power Companies. John F. C. Snell. Read before the Incor. Munic. Elec. Assn. Deals with the cost of generation, showing that small districts will find it more economical to take supply from outside source when available. 3300 w. Elec. Engr, Lond—June 22, 1906. No. 77777 A.

Hydro-Electric.

A Hydro-Electric Generating Station at South Bend, Ind. Illustrated detailed description of a generating station on the left bank of the St. Joseph River and its equipment. 2000 w. Eng Rec—July 14, 1906. No. 77935.

A Model Turbine Power Station. Illustrated description of the new turbine plant built by the Baltimore Electric Power Company. 2500 w. Eng Rec—July 21, 1906. No. 78075.

Contracting for Use of Hydro-Electric Power on Railway Systems. G. A. Harvey. Read before the N. Y. State Convention. Discusses the effect of load factor on the cost of power, and methods of billing for power, and matters of related interest. 2500 w. St Ry Jour—June 30, 1906. No. 77729, C.

Hydro-Electric Plant on the Upper Adda (Impianto Idro-Elettrico sull' Alta Adda). An account of the plans proposed for the establishment of an electric station on the Adda for the tranmission of power to Milan. 4000 w. Il Monitore Tecnico—June 30, 1906. No. 78180 D.

The Design of Hydro-Electric Installations as a Whole. E. F. Cassel. Abstract of a paper read before the Nat. Elec. Lgt. Assn. Discusses some of the problems met in designing hydraulic installations. 1800 w. Eng Rec—June 30, 1906. No. 77720.

The Hydro-Electric Power Plant of the Nevada Power Mining & Milling Co. J. D. Galloway. Illustrated detailed description of this plant in Inyo Co., California which transmits power to Goldfield and Tonopah, in Nevada. An excellent example of long span construction. 2500 w. Eng Rec—June 30, 1906. No. 77718.

The Power Plant of the Electrical Development Company, of Ontario. F. O. Blackwell. Read before the Can. Elec. Assn. Detailed description of the plant and the transmission line. 3000 w. Elec Rev, N Y—July 28, 1906. No. 78259.

Parallel Running.

Notes on the Parallel Running of Alternators (Vorrichtung zum Selbsttätigen Parallelschalten von Drehstrommaschinen). Dr. G. Benischke. Describing automatic synchronizing devices for starting alternators in parallel. 3000 w. Elektrotech Zeitschr—July 5, 1906. No. 78168 B.

Paris.

The New St. Denis Electric Plant at Paris. C. L. Durand. Illustrated description of an interesting steam turbine plant under construction, and of its equipment. 6000 w. Elec Rev, N Y—July 28, 1906. No. 78258.

LIGHTING.

Arc Lamps.

Influence of the Curve of Electromotive

Force upon Arc Lamps (Einfluss der Kurve der Elektromotorischen Kraft auf Bogenlampen). C. Zorawski. Showing the influence of an irregular wave form in causing the production of noise in arc lamps. 1000 w. Elektrotech Zeitschr—June 28, 1906. No. 78164 B.

Incandescent.

A New Method of Assorting Incandescent Lamps According to Age. Dr. Clayton H. Sharp. Explains a method sufficiently exact for the separation of good lamps from those that have depreciated, which requires no special apparatus or skill. 1800 w. Elec Wld—July 7, 1906. No. 77868.

Large Rooms.

The Lighting of Large Public Rooms. J. R. Cravath and V. R. Lansingh. An illustrated article considering the lighting of hotel lobbies, large railroad depots, halls, etc., 2000 w. Elec Wld—July 7, 1906. No. 77867.

MEASUREMENT.

Circle Diagram.

Simple Circle Diagram of the Single-Phase Induction Motor. A. S. McAllister. Shows that when a polyphase induction motor is compelled to operate as a single-phase machine, by cutting one of the supply wires its current locus is still approximately a circle; but the circle shrinks in diameter about 50%. 2400 w. Elec Wld—June 30, 1906. No. 77755.

Currents.

Measurement of Feeble High-Frequency Currents. Bela Gati. On the measurement of very feeble telephonic currents outlining a method which does not require a special source of current. 1600 w. Elec Wld—June 30, 1906. No. 77756.

Harmonics.

Graphical Treatment of Higher Harmonics. R. Hellmund. Describes an interesting graphical method for determining the current which flows through impedances of different constants when subjected to a non-sinusoidal electromotive force. 600 w. Elec Wld—June 30, 1906. No. 77753.

Magnets.

A Chart for Use in Magnet Design. L. F. Howard. Gives a chart designed to give a quick and convenient means of obtaining the size of wire, or voltage, for different conditions. 1000 w. Elec Jour—July, 1906. No. 78033.

Photometry.

Some Causes of Error in Photometry. Lancelot W. Wild. Discusses errors due to several causes, and the general principles for the avoidance of angularity error. 1600 w. Elect'n, Lond—July 20, 1906. No. 78296 A.

Power.

The Sale and Measurement of Electric Power. S. B. Storer. Read before the N. Y. State Convention. Considers briefly the cost of production of power from hydro-electric plants and from steam plants and the question of rate making and methods of charging. 3500 w. St Ry Jour—June 30, 1906. No. 77730 C.

MOTORS.

Comparison.

Comparison of Two- and Three-Phase Motors. Bradley McCormick. Gives a comparison of the distribution factor, flux-variation factor, current density in rotor and stator, and the leakage factors. 1500 w. Pro Am Inst of Elec Engrs—June, 1906. No. 78041 D.

Induction Motors.

The Effect of Voltage and Frequency Variations on Induction Motor Performance. Gerard B. Werner. An analysis dealing with the effects on the motor performance caused by variations in the supply circuit. 2500 w. Elec Jour—July, 1906. No. 78032.

Inter-pole.

Direct-Current Motor Design as Influenced by the Use of the Inter-Pole. C. H. Bedell. An explanation of the advantages gained by use of inter-poles. 2400 w. Pro Am Inst of Elec Engrs—June, 1906. No. 78043 D.

Speed Control.

Direct Current Motor Speed Control. J. H. Newby. Read before the Elec. Assn. of N. S. W. Discusses methods of varying the speed of direct current motors, including the multiple voltage of three-wire balance system. 2200 w. Aust Min Stand—May 23, 1906. Serial. 1st part. No. 77780 B.

TRANSMISSION.

Arresters.

Some Experiences with Lightning and Static Strains on a 33000 Volt Transmission System. Farley Osgood. Explains the actions of the multigap series resistance type of arrester unit, and the multigap type of arrester unit without the series resistance, experienced during the years 1904 and 1905 on a system in Connecticut. Ills. 3000 w. Pro Am Inst of Elec Engrs—June, 1906. No. 78044 D.

High Voltage.

100,000-Volt Experimental Transmission Line. K. Wernicke. Illustrates and describes an experimental line near Berlin, which has been tested and successfully proven that an installation operating at 100,000 volts is feasible when properly insulated. 1700 w. Elec Wld—July 14, 1906. No. 77961.

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Low Frequency.

Stanley's System of Transmitting and Utilizing Low-Frequency Currents. Describes a system in which the principal advantages of alternating-current distribution and direct-current motors are present. Ills. 2000 w. Sci Am Sup—June 30, 1906. No. 77713.

Poles.

A New System for Line-Wire Poles (Eine Neue Befestigung von Leitungsmasten). S. Herzog. Describing a combination of wooden pole and concrete base, especially adapted for telegraph and electric transmission lines. 2000 w. Elektrotech u Polytech Rundschau—June 14, 1906. No. 78188 D.

Protective Apparatus.

Methods of Testing Protective Apparatus. E. E. F. Creighton. Treats of the methods of testing arresters and dielectrics, and gives the conditions and precautions found necessary to obtain useful results. 8000 w. Pro Am Inst of Elec Engrs—June, 1906. No. 78045 D.

Protective Apparatus for Lightning and Static Strains. H. C. Wirt. Discusses in detail the methods of protection used for high-tension transmission lines. Ills. 5000 w. Pro Am Inst of Elec Engrs—June, 1906. No. 78046 D.

Three-Phase.

Direct-Current Transmission in Competition with the Three-Phase Alternating-Current System for Milan. Explains the general condition at Milan and the comparison made of the two schemes for the supply of power, which resulted in favor of the three-phase system. 800 w. Elec Rev, Lond—June 29, 1906. No. 77886 A.

Towers.

Towers for the Transmission Line between Ballston and Amsterdam, New York. Illustrates and describes the towers being built for a transmission line between Spier Falls and Utica, N. Y. 1000 w. Elec Rev, N Y—June, 30, 1906. No. 77736.

MISCELLANY.

Agriculture.

The Application of Electric Motors to Agricultural Purposes. Franz Koester. With numerous practical illustrations of examples in a profitable field for the extension of electric power. 2500 w. Engineering Magazine—August, 1906. No. 78192 B.

INDUSTRIAL ECONOMY

Accounting.

Method in Engineering Work. A. D. Williams, Jr. Describes a method devised for handling the engineering work, in shop and offices, for a concern building traveling cranes in a wide variety of sizes and types. 6000 w. Ir Age—July 12, 1906. No. 77904.

Address.

Address of Sir Alexander Richardson Binnie. Reviews the history and growth of the various branches of engineering, and considers those whose names are associated with its development. 7000 w. Inst of Civ Engrs—Nov. 7, 1905. No. 78016 N.

Engineering Honor. Schuyler Skaats Wheeler. President's address. Discusses the duties of an engineer to his client, the public, to the enginering societies, and gives an appendix on professional ethics. 12000 w. Pro Am Inst of Elec Engrs—June, 1906. No. 78040 D.

Civil Engineers.

Requisites of a Civil Engineer. Gen. William Sooy Smith. Gives some facts of interest from the experience of the writer, and discusses the requisites of a good engineer. 5000 w. Trans Assn of Civ Engrs of Cornell Univ—1906. No. 78037 G.

Co-operation.

Co-operation. Henry W. Thornton. Read before the Traffic Club of Pittsburgh. Especially considers co-operation between the traffic and operating departments of the same railroad, and co-operation between a railroad and an industry. 5500 w. Pro St Louis Ry Club—June 8, 1906. No. 77768.

Cost Keeping.

A Tool for Cutting Down Costs. F. E. Webner. The first of a series of twelve articles on cost keeping. 3000 w. Ir Trd Rev—July 5, 1906. No. 77807.

Dumping.

Some Dumping Dodges. William Taylor Heslop. Illustrated description of devices used in South Africa for loading and unloading material. 1200 w. Mines & Min—July, 1906. No. 77909 C.

Education.

Technical Education in Relation to Industrial Development. Charles G. Washburn. A review of the history of industrial development and industrial education in the United States. A Commencement address. 10000 w. Jour Worcester Poly Inst—July, 1906. No. 78003 C.

The Armstrong College, Newcastle-on-Tyne. Illustrated detailed description of the new extensions and the uses to which

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they are to be applied. 3000 w. Engr, Lond—July 6, 1906. No. 77990 A.

The Education of Mining Engineers. J. W. Gregory. Abstract of a paper read before the Inst. of Min. Engrs. Especially considers the needs of Great Britain, discussing the requirements. 3500 w. Ir & Coal Trds Rev—June 22, 1906. No. 77790 A.

The Relation Between Technical Education and Industrial Progress. Robert H. Richards. States facts relating to the development in the United States, and explains obstacles encountered. 6000 w. Tech Qr—June, 1906. No. 78005 E.

Egypt.

Egypt in 1905. Reviews such portions of Lord Cromer's annual report as are of interest to engineers. 4000 w. Engr, Lond—June 22, 1906. No. 77798 A.

Seven Years in the Soudan. Information from Lord Cromer's last report concerning the work accomplished during the last seven years. 2000 w. Engr, Lond—July 13, 1906. No. 78223 A.

Electricity.

Application of Electricity in the Development of American Industries and Manufacturing. Charles F. Scott. Remarks on power as the fundamental element in manufacturing operations, and the new methods made possible by electric power. 2500 w. Ind Wld—June 28, 1906. No. 77751.

Experiment Station.

The Engineering Experiment Station of the University of Illinois. An illustrated article giving a brief outline of the equipment of this station and the work it is purposed to carry on. 1200 w. Elec Rev, N Y—July 21, 1906. No. 78087.

Exposition.

The Milan International Exposition (L'Exposition Internationale de Milan). E. Lemaire. A well illustrated description of the buildings and grounds of the Milan exposition, celebrating the successful completion of the Simplon tunnel. 3500 w. Génie Civil—June 9, 1906. No. 78120 D.

Labor.

Chinese Labor in the Light of Modern Industry. Barrett Smith. A record of practical experience with coolie labor, expressing an optimistic opinion as regards the availability of Chinese labor for great engineering undertakings. 3500 w. Engineering Magazine—August, 1906. No. 78198 B.

Municipal Ownership.

Municipal Ownership in Germany. Hugo R. Meyer. Discusses the record of municipal failure in public service industries and the effect, especially in the development of electric railways. 2200 w. Elec Ry Rev—July, 1906. No. 77963.

Municipal Ownership: Three Important Changes in the Public Point of View. Charles Whiting Baker. Editorial presenting the substance of an address at Ithaca, N. Y., opening a discussion on the subject of municipal ownerships. 2000 w. Eng News—July 5, 1906. No. 77822.

Steel Industry.

The Growth of the Steel Industry. Harold Baxter. Discusses the cause of the present activity in the steel market, and the probability of finding iron ore in Colorado. 1800 w. Min Rept—July 19, 1906. No. 78091.

Tees-side.

Tees-side as an Industrial Center. A report of the project of developing districts outside of the large cities, for manufacturing purposes, presenting the considerations advanced to influence the choice of Tees-side for industrial works. 3000 w. Engng—July 6, 1906. Serial. 1st part. No. 77979 A.

Workmen's Houses.

General and Special Considerations upon the Design and Construction of Workmen's Dwellings (Allgemeines und Spezielles über den Bau und die Einrichtung von Arbeiterwolinungen). Dr. Henrici. A review of existing practice, showing the importance of combining convenience and comfort, with correct sanitation, with moderate cost. 3500 w. Zeitschr de Ver Deutscher Ing—June 16, 1906. No. 78102 D.

MARINE AND NAVAL ENGINEERING

American Navy.

American Naval Organization and the Personnel Law of 1899. George W. Melville. Discusses the working of this system, replying to points in a paper by Admiral S. B. Luce, in the *North American Review*. 3000 w. Cassier's Mag—July, 1906. No. 78000 B.

Battleships.

H. M. Battleship "Agamemnon." Illustrates and describes this recently launched vessel. Also editorial discussion. 3000 w. Engng—June 22, 1906. Serial. 1st part. No. 77795 A.

Modern Warships. Sir William White. Cantor lecture delivered Jan. 29, 1906. Describes the characteristic features of modern warships; materials and methods of construction; armor protection and armament; improvements in propelling

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machinery, growth in dimensions and cost. 5000 w. Jour Soc of Arts—June 29, 1906. Serial. 1st part. No. 77873 A.

The New Japanese Battleships "Katori" and "Kishima." J. B. Van Brussel. Illustrated detailed descriptions of the vessels and their equipment. 1600 w. Sci Am—July 21, 1906. No. 78062.

Boilers.

See Mechanical Engng., Steam Engng.

Coaling.

The Coaling of Ships at Sea (Le Ravitaillement en Mer des Navires). A Bidault des Chaumes. Describing especially the Temperley conveying apparatus, including the device by which the bucket is automatically locked to, and released from the carriage. 3000 w. Génie Civil—May 19, 1906. No. 78115 D.

Compass.

* The Principles of the Deviation of the Compass and Its Correction. L. M. Nulton. An attempt to explain, by simple laws of magnets, how deviation is produced by the iron of a ship, and how it may be corrected. An explanation of principles involved, based upon the physical laws of attraction and repulsion of magnets. Ills. 6400 w. Pro U S Nav Inst—June, 1906. No. 78028 G.

Coupling.

The Lovekin Improved Inboard Coupling for Line and Propeller Shafts. Luther D. Lovekin. Considers a type of coupling being made for the U. S. battleship New Hampshire, explaining the advantages claimed. Ills. 1700 w. Jour Am Soc of Nav Engrs—May, 1906. No. 78027 H.

Cranes.

New Tower Cranes for Shipbuilding (Neuere Elektrisch Betriebene Helling-Turmdrehkrane). Illustrating some remarkable traveling tower jib cranes of 6 tons capacity on towers 35 metres high; built by the Benrath Machine Works for Bremen shipyards. 2000 w. Schiffbau—July 11, 1906. No. 78156 D.

Cruisers.

Steam Trials of H. M. Armored Cruiser "Cochrane." A report of trials, the results, so far as speed is concerned, proving quite satisfactory. 1200 w. Engng—July 13, 1906. No. 78216 A.

Trial Performance of United States Cruiser St. Louis. L. E. Baldt. An illustrated article giving a description of the vessel and its equipment, and of the trial trip. 4800 w. Int Marine Engng—August, 1906. No. 78201 C.

U. S. Armored Cruiser Tennessee. Lewis Hobart Kenney. Illustration, with detailed description of the machinery and tests. 12500 w. Jour Am Soc of Nav Engrs—May, 1906. No. 78026 H.

Design.

Approximate Dimensions for a "Compromiseless Ship." Richard D. Gatewood. Aims to show how to design the principal dimensions of such a ship. 4500 w. Pro U S Nav Inst—June, 1906. No. 78030 G.

Gas Power.

See Mechanical Engineering, Combustion Motors.

Launch.

The Steam Launch Rose en Soleil. Illustrated detailed description of this motor-boat which beat all competitors at the Liverpool trials. 1200 w. Engr, Lond—July 13, 1906. No. 78224 A.

Liners.

The New Cunarders. Sir William H. White, in the *London Times*. A discussion of steamship propulsion, and the increase in speed required for these new vessels. 2000 w. Marine Rev—July 12, 1906. No. 77953.

The Twin Screw Passenger and Freight Steamer Kaiserin Auguste Victoria (Der Doppelschrauben-Passagier und Frachtdampfer Kaiserin Auguste Victoria). A detailed description of the new Hamburg-Amerika liner, with numerous illustrations. Serial. Part 1. 1800 w. 1 plate. Schiffbau—June 27, 1906. No. 78155 D.

The Twin-Screw Steamship Kaiserin Auguste Victoria (Der Doppelschraubendampfer Kaiserin Auguste Victoria). W. Kaemmerer. A very completely illustrated account of the new Hamburg-Amerika liner, including details of the equipment and machinery. 4000 w. 4 plates. Zeitschr d Ver Deutscher Ing—July 7, 1906. No. 78110 D.

Progress.

Technical Progress in the Merchant and Military Marine in the Last Decade (Die Technischen Fortschritte in der Handels und Kriegsmarine im Letzten Jahrzehnt). Hr. Ilgenstein. A review of the latest developments, including greater strength, stability and control; the use of electricity, telephones, wireless telegraphy, etc.; also submarines and torpedo boats. 4000 w. Zeitschr d Ver Deutscher Ing—June 23, 1906. No. 78105 D.

Steamers.

New Passenger and Freight Steamer City of Stamford. Illustrated detailed description of a new steamer for service between New York and Stamford. 700 w. Naut Gaz—July 12, 1906. No. 77913.

The New Canadian Pacific Twin-Screw Steamers. An illustrated description of the Atlantic liners "Empress of Britain" and "Empress of Ireland." 3000 w. Engng—July 20, 1906. No. 78313 A.

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Steamships.

New Steamships for Pacific Coast. Illustrated description of a design for two fine coasting vessels for service between San Francisco and Seattle. 1600 w. Naut Gaz—July 19, 1906. No. 78086.

Transport.

The Military Transport Steamer Borussia (Der Truppentransportdampfer Borussia). Hugo Buchholz. A detailed description of the steamer built at the Krupp Germaniawerft for the Hamburg-Amerika Line, and adapted for military transport service in time of war. 3000 w. 1 plate. Zeitschr d Ver Deutscher Ing—June 23, 1906. No. 78103 D.

Turbines.

Marine Turbines in Service. Robert S. Riley. Discusses the turbine question and its advantages and disadvantages. 2500 w. Int Marine Engng—August, 1906. No. 78203 C.

MECHANICAL ENGINEERING

AUTOMOBILES.

Adams-Hewett.

The Adams-Hewett Car. The first of a series of articles describing the details of this light, low-priced car. Ills. 900 w. Auto Jour—June 30, 1906. Serial. 1st part. No. 77881 A.

Berliet.

The Berliet Petrol Cars. Illustrated detailed description of these chain-driven cars. 1000 w. Auto Jour—July 21, 1906. No. 78294 A.

Carburetters.

Adapting the Carburetter Especially in Regard to Multi-Cylinder Engines. Suggestions resulting from observations of carburetter action. 2500 w. Autocar—July 7, 1906. No. 77967 A.

Congress.

The III International Congress of Automobilism at Milan (III Congresso Internazionale di Automobilismo in Milano). A series of reports by specialists upon the various departments of automobile construction as represented at the Milan exposition. Six articles. 10000 w. L'Industria—June 3, 10, 17, 24, July 1, 8, 1906. No. 78179 each D.

Decauville.

The 12-16 H. P. Decauville. Illustrates and describes the chassis of this car, which shows several distinctive and useful features. 2000 w. Autocar—July 21, 1906. No. 78293 A.

Gears.

Speed Changing Gears—The Planetary System. An illustrated explanation of the principles of its operation, and information relating to its use. 1800 w. Automobile—July 26, 1906. No. 78262.

Speed Changing Gears—The Sliding Gear. Diagram and description of typical three speed and reverse sliding gear transmission with direct drive on the high speed. 2300 w. Automobile—July 12, 1906. No. 77912.

Indicators.

Indicated Horse-Power and Indicators. Harold H. Brown. An explanation of the theoretical indicator and giving illustrated description of various types and of the "Manograph." 3500 w. Automobile—July 26, 1906. No. 78263.

Industrial Vehicles.

The Commercial Motor Vehicle in Great Britain. Ernest F. Mills. An illustrated review of the progress of this industry in Great Britain, giving related information. 2500 w. Cassier's Mag—July, 1906. No. 77997 B.

Manograph.

Indicating an Auto Motor at 1000 R. P. M. H. F. Donaldson. Illustrated description of an instrument, called a "manograph," which gives a photographic record of the work of the motor. Its operation is explained. 2500 w. Automobile—July 5, 1906. No. 77803.

Motor-Cycles.

The Design of the Motor Bicycle. Discusses the lines along which improvement is necessary. 1200 w. Engng—June 22, 1906. No. 77794 A.

Motor Wagon.

A Powerful Motor Wagon with Four Driving Wheels. Illustrated descriptions of a motor vehicle in which all the wheels are utilized in driving, steering and braking. 1000 w. Eng News—July 12, 1906. No. 77928.

Nevada.

Automobiling in the Desert. An illustrated article describing travel by automobiles in the mining regions. 2200 w. Min Wld—July 14, 1906. No. 77956.

Race.

The Grand Prize of the Automobile Club of France for 1906 (Le Grand Prix de l'Automobile Club de France en 1906). Ch. Dantin. A description of the run over the circuit de la Sarthe, won by Szisz, in a Renault machine. 3000 w. Génie Civil—June 30, 1906. No. 78123 D.

Renault.

The Winning Car of the Grand Prix, and the Detachable Rim. Illustrated detailed description of this Renault car, and the removable system of wheel rims used. 1500 w. Sci Am—July 28, 1906. No. 78267.

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Siddeley.

The 32 H. P. Siddeley Car. Illustrated detailed description. 1200 w. Autocar—June 30, 1906. Serial. 1st part. No. 77883 A.

COMBUSTION MOTORS.

Alcohol.

Alcohol Fuel for Explosion Engines. Abstract translation of a paper by Karl Fehrmann, read before the German Auto. Tech. Assn. A report of investigations and results showing that the prospects of alcohol supplanting gasoline are not encouraging. 4500 w. Mech Engr—June 30, 1906. No. 77879 A.

Carbureter.

A New Adjustable Float-Feed Carbureter for Use with Gasoline or Alcohol. Illustrates and describes a carbureter which has a coil spring, that acts as a throttle in connection with a slightly movable needle valve placed in the spraying nozzle. 700 w. Sci Am—July 21, 1906. No. 78060.

Combustion Chamber.

Experiments on a Constant-Pressure Generator. C. M. Garland. A detailed description of experiments with a pressure generator, in which the products of combustion are mixed with steam generated by the heat of the combustion. 2500 w. Engineering Magazine—August, 1906. No. 78195 B.

Diesel Motor.

Application of the Diesel Motor to Navigation on the Lake of Geneva (Le Moteur Diesel et son Application à la Navigation sur le Lac Leman). P. Hoffet. A general account of the theory and high efficiency of the Diesel motor, with especial reference to the installation on the vessel "Venoge" on the lake of Geneva. 5000 w. Bull Tech de la Suisse Rom—June 25, 1906. No. 78173 D.

The Diesel Motor (Il Motore Diesel). A fully illustrated account of the manufacture and operation of the Diesel petroleum motor, with especial reference to the exhibits at Milan. Two articles. 4000 w. L'Industria—May 20, 27, 1906. No. 78178 each D.

Engines.

Four-Cylinder Reversible Internal-Combustion Engine. Illustrated description of a design of 4-cylinder vertical internal-combustion engine on the reversing type. 1200 w. Mech Engr—June 23, 1906. No. 77783 A.

Gas Engines.

Cycles, Design, and Regulation of Internal-Combustion Motors (Mode de Réglage, Cycles, et Construction des Moteurs à Combustion Interne). R. E. Mathot. A paper presented at the Liège Congress, giving an exhaustive review of the present state of the art. 15000 w. Revue de Mécanique—May 31, 1906. No. 78175 E + F.

Gas Engine Calorimetry. F. E. Matteson. A report of experiments made to determine the proportionate distribution of the heat. 1800 w. Am Mach—Vol. 29. No. 30. No. 78229.

Measurement of Friction in Gas Engines. A. H. Burnand. Explains a method of estimating friction by retardation curves, giving investigations made by the writer. 2000 w. Engng—July 13, 1906. No. 78220 A.

Some Large Gas-Engines. Illustrates and describes a large gas-engine, and gas-driven blowing-engines built in Germany. 1200 w. Engng—July 6, 1906. No. 77980 A.

Gas Power.

A Naval Gas Engine. M. Joachimson. Illustrated description of a marine engine and producer developed by M. Emil Capitaine, and an account of the methods used in overcoming some of the difficulties encountered. 2200 w. Mach, N Y—July, 1906. No. 77706 C.

Gas Driven Electric Power System. J. R. Bibbins. Illustrated description of such a system as exemplified in the Warren & Jamestown railway plant. 8000 w. Pro Engrs' Soc of W Penn—July, 1906. No. 78247 D.

Gas Power for Marine Work. Godfrey M. S. Tait. An investigation of the gas producer as a fuel generator for this class of work. 1000 w. Int Marine Engng—Aug., 1906. No. 78202 C.

Gas Turbine.

The Gas Turbine. Some Tests of its Practical Efficiency. C. E. Lucke. Data and results of experiments with compressed air upon a De Laval wheel, showing the improbability of high efficiency. 3000 w. Engineering Magazine—August, 1906. No. 78191 B.

Suction Gas.

Suction Gas Producer Plant at Wichita, Kan. Illustrated detailed description of a plant for electric driving of motors, elevator service, and lighting in a factory. 1800 w. Engr, U S A—July 16, 1906. No. 77995 C.

Suction Gas Producers for Tarry Fuels (Sauggaserzeuger für Teerbildende Brennstoffe). C. Diegel. Illustrating especially the Pintsch producer, in which the gas is drawn off from the middle of the fuel bed. 2000 w. Stahl u Eisen—July 1, 1906. No. 78148 D.

Valve Gear.

Thorneycroft's Valve Gear for Reversible Explosion Engines. Illustrated description of an arrangement of valve operating mechanism suitable for use with 4-cycle reversible internal-combustion engines. 1000 w. Mech Engr—July 21, 1906. No. 78304 A.

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Valves.

Gas Engine Valve Construction. H. S. Brown. Considers in detail the requirements of each section of an inlet or exhaust valve for gas, gasoline, or oil engines, and their design and construction. Ills. 1200 w. Ir Age—July 19, 1906. No. 78013.

HEATING AND COOLING.

Hot Air.

An Improved Application of Hot-Air Heating. A. O Jones. Brief description of this system with an improved type of side-wall register for first floor rooms. Ills. 800 w. Heat & Vent Mag—July, 1006. No. 78242.

Fads and Fallacies in Hot-Air Heating. R. S. Thompson. Gives examples illustrating the wrong ideas held by many people in regard to the heating of buildings. 4500 w. Heat & Vent Mag—July, 1906. No. 78240.

Hot Water.

An Interesting Heating Plant. A. T. Hoyt. Illustrated description of a hot water plant which heats four greenhouses and a residence successfully. 2300 w. Dom Engng—July 14, 1906. No. 77941.

The Elimination of Redundant Parts in the Forced Circulation of Hot Water. A. H. Barker. Read before the Am. Soc. of Heat. & Vent. Engrs. Illustrated description of a system which dispenses with the calorifier tube, its traps and valves, and the redundant parts of the pump. 4500 w. Dom Engng—July 21, 1906. No. 78083.

Radiation.

Heat Losses and Heat Transmission. Walter Jones. Read at meeting of the Am. Soc. of Heat. & Vent. Engrs. Discusses methods of calculation for ascertaining what radiator, or pipe surface for hot water, will be required to give a desired temperature. 4500 w. Met Work—July 21, 1906. No. 78049.

Radiation from Extended Ribbed Surfaces in Steam Heaters (Wärmeabgabe der Rippenheizflächen bei Dampfheizkörpern). E. Ritt. A review of Rietschel's formula, discussing the heat units given off for a given temperature difference. 1000 w. Gesundheits-Ingenieur—July 7, 1906. No. 78157 B.

Wall Radiators vs. Long Pipe Coils. J. A. Donnelly. Considers the use of wall radiators in the place of pipe coils for heating buildings in which long coils are usually employed. 900 w. Heat & Vent Mag—July, 1906. No. 78241.

Refrigeration.

Refrigerator Design. Charles E. Edgar. Calls attention to faults in the usual arrangement of evaporating coils, and gives suggestions. Ill. 3000 w. Ice & Refrig—July, 1906. No. 77763 C.

Refrigeration System of the Model New Abattoir in New York City. Illustrated description of the provisions for cold storage, and a refrigerating plant designed especially for the preservation of dressed meats. 4000 w. Eng Rec—July 14, 1906. No. 77937.

Some Faults in Ice Machines. William Nottberg. Points out bad features of the present ice machines and accessories. 2000 w. Ice & Refrig—July, 1906. No. 77762 C.

The Commercial Importance of Refrigerating Processes (Wirtschaftliche Wirkungen der Kältetechnik). Hr. v. Linde. A review of the development of refrigerating machinery in the last 25 years, showing its great commercial importance in breweries, slaughter houses, storage warehouses, etc. 3000 w. Zeitschr d Ver Deutscher Ing—June 30, 1906. No. 78109 D.

HYDRAULICS.

Flow.

A Velocity Registering Device (Construction d'un Appareil à Enregistrer les Vitesses). M. Parenty. Describing a form of recorder for use with a modification of the Pitot tube for registering the flow of water through pipes and conduits. 7500 w. Ann d Ponts et Chaussées—I Trimestre, 1906. No. 78133 E + F.

Intensifier.

Steam Hydraulic Intensifier for Hydraulic Presses. Illustrates and describes an arrangement of drop valves, which close positively and are not liable to leak, used for controlling the admission and exhaust of steam to and from the steam cylinder of the intensifier. 1200 w. Mech Engr—July 7, 1906. No. 77975 A.

Power.

Sale of Water-Power from the Power Company's Point of View. C. E. Parsons. Read before the N. Y. State Convention. Describes the system of the Hudson River Electric Power Co., and some of the important works in connection with its high-voltage of transmission, and discusses methods of making contracts for railway energy. 5000 w. St Ry Jour—June 30, 1906. No. 77731 C.

MACHINE WORKS AND FOUNDRIES.

Air Furnaces.

Air Furnace Practice. Ralph H. West. From a paper read before the Am. Found. Assn. An illustrated article describing details of these furnaces and their working. 2000 w. Ir Age—July 5, 1906. No. 77771.

Boring.

An Ingenious Contrivance. Edward Sette. Illustrated description of an arrangement for boring connecting rod brasses on a blacksmith's drill press. 500 w. Ice & Refrig—July, 1906. No. 77764 C.

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Brass.

Brass Melting and Mixing. Erwin S. Sperry, in *The Brass World*. Considers their effect on the quality of the casting. 4000 w. Mech Engr—July 14, 1906. No. 78209 A.

Cams.

Laying out Cams on the Castings. R. E. Weinland. Describes simple and practical methods for use in laying out ordinary cams. Ills. 1500 w. Am Mach—Vol. 29. No. 29. No. 78051.

The Design of Cams. W. O. Horsnaill. Gives examples illustrating the correct method of designing cams. 1300 w. Engr, Lond—July 20, 1906. No. 78316 A.

Castings.

Designing and Building a Machine Part. H. P. Fairfield. Illustrated description of a casting from its first inception, to the point where it becomes a finished part. 1200 w. Mach, N Y—July, 1906. No. 77705 C.

Direct Castings from the Blast Furnace. W. H. Butlin. Reports results obtained by mixing ores of different composition in the blast furnace, claiming that with necessary knowledge and skill in manufacture, as good results can be obtained as with a cupola. Ills. 2000 w. Cassier's Mag—July, 1906. No. 77999 B.

Chuck.

A Simple Magnetic Chuck. R. V. C. Brook. An illustrated description of a chuck designed to hold irregular castings and forgings such as milling cutters, dies, punches, etc., which had to be ground on their faces and could not be conveniently held in an ordinary chuck. 500 w. Mech Engr—July 14, 1906. No. 78210 A.

Compass.

The Compass Machine. C. H. Claudy. Illustrated description of the machine used for cutting compass cards. 1000 w. Am Mach—Vol. 29. No. 27. No. 77808.

Crank Shafts.

The Manufacture of Crank Shafts (Die Herstellung Gekröpfter Wellen). Fr. Schraml. Describing the methods and special tools for machining multiple crank shafts from solid steel forgings. 2500 w. Zeitschr d Ver Deutscher Ing—July 7, 1906. No. 78113 D.

Design.

Essentials in Engineering Design. A. T. J. Kersey. Discusses the essential features of a good design and the qualifications a young engineer should possess to produce designs satisfactory to the works manager. 1800 w. Mech Engr—June 30, 1906. No. 77876 A.

Dies.

Punch and Die Work. E. R. Markham. An illustrated article describing methods used in this work, and the different operations. 3300 w. Mach, N Y—July, 1906. Serial. 1st part. No. 77707 C.

Electric Driving.

First Electric Motor-Driven Rail Mill. Illustrated description of the equipment of the Edgar-Thomson plant at Bessemer, Pa. 1500 w. Ind Wld—July 7, 1906. No. 77824.

Electrical Works.

The Electrical Works of the Allis-Chalmers Company. Illustrated description of works located at Norwood, a suburb of Cincinnati, Ohio. 1800 w. Elec Rev, N Y—July 7, 1906. No. 77832.

Factories.

The Iron-Clad Manufacturing Company. An illustrated article describing the facilities for the welfare of employees, and some interesting things from a mechanical standpoint of this factory in Brooklyn. 3700 w. Am Mach—Vol. 29. No. 30. No. 78230.

Foundry.

Dark Secrets in Foundry Practice. William H. Parry. Read at meeting of Am. Found. Assn. Refers to prevalent practices which are guarded as secrets which are of little value. 1200 w. Ir Trd Rev—July 26, 1906. No. 78261.

Grinding.

Recent Grinding Machines for Tools (Neuere Schleifmaschinen für Werkzeuge). G. Schlesinger. Illustrating improved machines for sharpening saws, twist drills, milling cutters, etc. 2000 w. 1 plate. Zeitsch d Ver Deutscher Ing—June 30, 1906. No. 78107 D.

Headstocks.

A Study in All-Gear Heads. Thomas R. Shaw. Explains the meaning of the term "all-gear," and gives illustrated descriptions of types. 2000 w. Mech Engr—July 14, 1906. Serial. 1st part. No. 78208 A.

Jigs.

Shop Tools and Methods. F. J. Le Card. Illustrated description of jig work. 600 w. Am Mach—Vol. 29. No. 28. No. 77922.

Lubrication.

Theory and Practice of Lubrication. J. W. G. Brooker. Abstract of a paper read before the Auto-Cycle Club. Considers solid and fluid friction, discussing the properties of lubricants and other related matters. 3000 w. Mech Engr—June 30, 1906. No. 77880 A.

Milling.

An English Slab-Milling Machine. James Vose. Illustrated description of a special high-speed slab-milling machine, designed for milling the sides of locomotive connecting rods, etc. 1000 w. Am Mach—Vol. 29. No. 27. No. 77810.

Molding.

Molding a Draw-bench Casting in a Flask, and also by Using the Floor as a Drag and Bedding, in the Pattern. R. H. Palmer. An illustrated article

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describing the differences in the construction of the patterns required to allow them to be molded easily in the two ways shown. 1800 w. Am. Mach—Vol. 29. No. 27, No. 77809.

Molding a Heavy Balance Wheel. Illustrates and describes a method which gave good results. 800 w. Am Mach—Vol. 29. No. 28. No. 77921.

The Position of Patterns in the Molds. Walter J. May, in the *English Mechanic and World of Science*. An illustrated article giving suggestions for a number of castings. 2500 w. Sci Am Sup—July 14, 1906. No. 77931.

Molding Machines.

Pattern Mounting on the Molding Machine. F. W. Hall. Discusses methods of mounting, illustrating by examples. 3000 w. Am Mach—Vol. 29. No. 28. No. 77920.

Pipes.

Modern Pipe Founding. H. A. Croxton. Read before the Am. Found. Assn. Remarks based on a pipe foundry with a yearly capacity of 60,000 tons, considering the choice of pig iron, flasks and cores, crane equipment, etc. 1700 w. Ir Age—July 19, 1906. No. 78014.

Piston-Rings.

Making a Piston-Ring. Illustrates and describes the processes by which piston-rings for Napier automobile engines are finished. 700 w. Auto Jour—June 30, 1906. No. 77882 A.

Pressure Tanks.

The Construction of Reservoirs to Sustain High Pressures (Sur la Construction des Réservoirs à Haute Pression). H. Royer. Discussing the construction of tanks or cylinders to contain compressed air, gases under high pressure, etc.; suggesting reinforcement by wire winding. 8000 w. Revue de Mécanique—June 30, 1906. No. 78176 E + F.

Press Work.

Some Progress in Simple Press Work. H. J. Bachmann. An illustrated discussion of operations on the power press in the working of sheet metals. 1500 w. Mach, N Y—July, 1906. No. 77704 C.

Punching.

Automatic Channel-Strip Punching-Machine. Illustration with brief description of a machine designed to punch holes at equidistant pitch in channel-shaped shrouding-rings used in a system of turbine blading. 300 w. Engng—June 29, 1906. No. 77892 A.

Reversing Gear.

Reversing Gear for Machine Tools. Illustrated description of a design of reversing gear for lathes and other similar tools. 1200 w. Mech Engr—July 7, 1906. No. 77974 A.

Shops.

Hicks Locomotive and Car Works. Illustrated description of Chicago works for repairing cars and locomotives, building new equipment, etc. 1200 w. R R Gaz—July 6, 1906. No. 77815.

Shop Extensions at the Plant of the Allis-Chalmers Co., Milwaukee, Wis. Illustrated descriptions of extensive additions to increase the capacity of the plant. 2000 w. Eng News—July 12, 1906. No. 77924.

Tools.

Tools for Machining Brass Type-Wheels. Edward Snyder. Illustrates and describes tools designed for the purpose of turning the rims and finishing the holes, shoulders, and ends of the hubs of cast-brass type-wheels. 3500 w. Am Mach—Vol. 29. No. 27. No. 77811.

Tool Works.

Worth Valley Tool Works, Keighley. Illustrated detailed description of these works which have been recently extended and rearranged. 2000 w. Engr, Lond—July 20, 1906. No. 78319 A.

Torsion Stresses.

Torsion Stresses at Sharp Cornered Shoulders on Shafts (Die Beanspruchung auf Verdrehen an einer Uebergangstelle mit Scharfer Abrundung). A Föppl. Showing the manner in which the cutting of a sharp shoulder on a shaft reduces the torsional resistance, and urging the use of liberal fillets. 2500 w. Zeitschr d Ver Deutscher Ing—June 30, 1906. No. 78108 D.

Welding.

Thermit Welding. R. P. C. Sanderson. Reviews the history of the methods covered in gaining success in the use of Thermit for welding locomotive frames. Also discussion. 3000 w. Pro S & S-W Ry Club—April 19, 1906. No. 78015 E.

MATERIALS OF CONSTRUCTION.

Abrasives.

Abrasive Materials. Joseph Hyde Pratt. Information concerning the production of abrasive materials, and their value. 2500 w. Ind Wld—June 28, 1906. No. 77752.

Alloys.

Losses in Making Alloys. Walter J. May. Calls attention to the unnecessary loss due to carelessness, giving suggestions. 800 w. Prac Engr—July 20, 1906. No. 78301 A.

The Physical Properties of Metallic Alloys (Physikalische Eigenschaften von Metallegerungen). Walter Rübel. A review of the modern study of alloys by the methods of metallography, showing the extent to which the properties are revealed by the appearance of the physical structure. 3500 w. Glasers Annalen—July 1, 1906. No. 78144 D.

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Cast Iron.

Malleable Cast Iron. G. A. Akerlind. Abstract of a paper read at meeting of the Scandinavian Tech. Soc. Reviews the manufacture of malleable cast iron in its different stages and considers it as a material of construction. 2500 w. Mech Engr—June 30, 1906. No. 77877 A.

The Beneficial Effects of Adding High Grade Ferro-Silicon to Cast Iron. Alexander E. Outerbridge, Jr. Read before the Am. Found. Assn. A report of experiments and results obtained by controlling the proportion of silicon, showing a reliable means of producing soft, but strong castings, from metal of medium grade. 3000 w. Ir & Coal Trds Rev—June 29, 1906. No. 77809 A.

Hardening.

The Molecular Changes in Hardening (Die Molekularen Vorgänge beim Hörten). Otto A. Böhler. An address explaining the phenomenon of the hardening of steel according to the solution theory, with illustrations of cooling curves. 2000 w. Oesterr Zeitschr f Berg u Hüttenwesen—June 30, 1906. No. 78151 D.

Impact Tests.

Repeated-Impact-Testing Machine at the National Physicial Laboratory. Illustrated description of a self-acting machine and its operation. 700 w. Engng—July 13, 1906. No. 78214 A.

Manganese.

Some Uses of Pure Manganese and Its Alloys. Remarks showing the large field of usefulness for this metal and its value to the metal founder. 1200 w. Ir & Coal Trds Rev—June 29, 1906. No. 77900 A.

Pig-Irons.

Specifications for Foundry Pig-Irons. W. B. Parker. Discusses the possibility of evolving a system without unduly disturbing present systems of supply. The composition and grading are considered. 7500 w. Ir & Coal Trds Rev—June 29, 1906. No 77898 A.

Steels.

Investigations on Steels Containing Copper (Recherches sur les Aciers au Cuivre). Pierre Breuil. Preliminary data upon copper-steel alloys showing the hardening action of the copper, and the singular points in the cooling curve. 1500 w. Comptes Rendus—June 18, 1906. No. 78126 D.

Nickel and Carbon Steels. Edward Dixon. Discusses results of recent investigations and their importance in the developments of petrol engines. 1000 w. Engng—July 6, 1906. No. 77985 A.

The Strength and Ductility of Steel. F. E. Cardullo. A discussion of the elements present in the steel, and how strong and how tough the various substances make it; also the effect of treatment during the process of manufacture. 2500 w. Mach, N Y—July, 1906. No 77701 C.

Testing Machine.

Purdue University Impact Testing Machine. W. K. Hatt and W. P. Turner. Read before the Am. Soc. for Test. Mat. Mentions three impact testing machines in the equipment of the laboratory, and illustrates and describes an improved machine for scientific and standard tests in compression and flexure. 2000 w. Ry & Engng Rev—June 30, 1906. No. 77735.

Tool Steel.

High-Speed Steel in the Factory. O. M. Becker. The seventh paper of the series discusses speeds and feeds with alloy steels showing the practical results which may be expected in the shop. 4000 w. Engineering Magazine—August, 1906. No. 78196 B.

High-Speed Tool Steel Tests. A report of the interesting tests of high-speed steel tools carried out on cast iron, at the University of Illinois Engineering Experimental Station, U. S. A. 2500 w. Engng—July 20, 1906. No. 78305 A.

The Internal Structure of Hardened and Tempered Tool Steel (Ueber den Innern Aufbau Gehärteten und Angelassenen Werkzeugstahls). E. Heyn & O. Bauer. A study of the relation of the constituents Troostite and Sorbite in hardened carbon tool steels. Serial. Part I. 3500 w. Stahl u Eisen—July 1, 1906. No. 78146 D.

Wastes.

Utilization of Waste Materials. From the German of Dr. Theodore Koller. Deals with the utilization of amber scrap, paraffine waste, furrier's waste, etc. 2500 w. Sci Am Sup—June 30, 1906. No. 77712.

MEASUREMENT.

Crank Motion.

Dynamic Force Plan for Crank Motions (Dynamischer Kraft plan des Kurbelgetriebes). Ferdinand Wittenbauer. A brief description of a method of projecting the action of the forces of a crank and connecting-rod motion in a graphical diagram. 1000 w. Zeitscher d Ver Deutscher Ing—June 16, 1906. No. 78101 D.

Flow.

Measuring Apparatus for Gases Flowing Through Pipes. Illustrated description of the Beardmore measuring and recording apparatus and its operation. 900 w. Mech Engr—June 30, 1906. No. 77878 A.

Gases.

Constants for Gases. Reviews the cal-

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culations of J. D. Van der Waals, Sr., and J. D. Van der Waals, Jr., and of Daniel Berthelot and others. 1400 w. Engng—July 20, 1906. No. 78307 A.

Hardness.

Apparatus for Determining Hardness by the Brinell Ball Test. The essential principle of this test consists in forcing a hardened steel ball partly into the test sample so as to effect a slight impression, the dimensions of which serve as a basis for determining the hardness. Ills. 1200 w. Am Mach—Vol. 29. No. 29. No. 78052.

Measuring Machine.

An Electrical Measuring-Machine for Engineering Gauges and Other Bodies. P. E. Shaw. Abstracted from the Phil. Trans. of the Roy. Soc. Describes a method having the advantage of being more sensitive than the old method, and giving an illustrated description of the machine used. 5000 w. Engng—June 29, 1906. No. 77896 A.

Planimeter.

The Polar Planimeter and Some of Its Special Applications. J. Y. Wheatley. A brief description of the instrument, its construction and operation, explaining the general principle. 4500 w. Am Mach—Vol. 29. No. 29. No. 78053.

Speed Indicator.

The Frahm Speed and Frequency Indicator (Der Frahmsche Frequenz und Geschwindigkeitsmesser). F. Lux. Illustrating the latest improvements in the Frahm indicator of vibrating springs; showing special receivers and transmitters for different speeds. 4000 w. Glasers Annalen—July 1, 1906. No. 78143 D.

Springs.

Diagram for Computing the Dimensions of Springs (Rechentafel für Feder berechnung). Dr. R. Proell. A graphical diagram for helical springs, enabling the relations of dimensions, extension, compression, and load to be determined by direct measurement. 1200 w. Zeitschr d Ver Deutscher Ing—July 7, 1906. No. 78114 D.

POWER AND TRANSMISSION.

Brakes.

Design of the Weston Load Brake. Ulrich Peters. Gives sectional views of one of the best mechanically designed brakes for cranes and other hoisting machinery and the calculations. 800 w. Mach, N Y—July, 1906. No. 77702 C.

Chain Belts.

History of the Link-Belt Industry. James M. Dodge. An illustrated review of the development. 3000 w. Ind Wld —June 28, 1906. No. 77749.

Coal Handling.

Tests of the Coal-Handling Plant at Breslau (Versuche an der Kohlenumladeanlage in Breslau). O. Kammerer. Detailed description and report of tests of cantilever coal-handling plant with diagrams from recording wattmeter and details of capacity and cost of operation. 4000 w. Zeitschr de Ver Deutscher Ing —July 7, 1906. No. 78111 D.

Transporter Cranes at Purfleet. Illustrated description of two rapid working hydraulic transporter cranes with grab-buckets, designed for lifting coal. 500 w. Engr, Lond—July 20, 1906. No. 78320 A.

Compressed Air.

Compressed Air as a Motive Power in the Quarry. George H. Gillman. Remarks on the applications of compressed air to quarry work, discussing some drawbacks and the remedies. 1000 w. Compressed Air—July, 1906. No. 77766.

German Designs of Air Compressors. M. Kurth. Illustrates and describes some of the more important designs, and those of particular interest. 2200 w. Am Mach—Vol. 29. No. 30. No. 78228.

Recent Extensions of the Employment of Compressed Air. Frank Richards. Notes on the development of the return-air pumping system, the electric-air rock drill, and the high pressure transmission of artificial gas. 2200 w. Eng News—July 26, 1906. o. 78231.

The Air Power Plants of the East River Tunnels of the Pennsylvania Railroad. An illustrated detailed description of these stations and their equipment. 5000 w. R R Gaz—July 27, 1906. No. 78264.

Elevators.

Electricity in Elevator Service. S. Morgan Bushnell. Discusses the relative advantages of electric and hydraulic equipments. 2500 w. Cassier's Mag—July, 1906. No. 78001 B.

Horse-Power.

What is Horse-Power? An elementary explanation of the term. Ills. 1700 w. Auto Jour—July 21, 1906. Serial. 1st part. No. 78295 A.

Power Plants.

Primary Considerations in the Designing of Power Plants. A. E. Dixon. The introduction of a series covering broadly the entire subject of the power station. The present article considers the preparation of plans and the supervision of contracts. 3000 w. Engineering Magazine—August, 1906. No. 78197 B.

Residence Plant.

Mechanical Equipment of the New Residence of Senator Clark in New York. Illustrated detailed description of the plant for a 7-story and basement stone structure, equipped with Turkish bath, swimming pool, refrigerators, elevator plant, indirect heating, air filters,

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temperature regulators, steam, etc. 6000 w. Eng Rec—July 7, 1906. No. 77837.

Spiral Gears.

The Spiral-Gear Problem Simplified. John Edgar. Gives practical rules, with examples showing their application. 1200 w. Am Mach—Vol. 29. No. 29. No. 78054.

Telpherage.

Electric Telpher for Conveying Coal. Illustrated description of the telpherage installation for conveying coal at the Bevan works of the Associated Portland Cement Mfrs., Ltd. 1500 w. Engng—July 13, 1906. No. 78217 A.

STEAM ENGINEERING.

Accessories.

Steam Plant Accessories. John T. Farmer. Presented before the Canadian Elec. Assn. Considers feed water, pipe coverings, fuel economizers, mechanical firing, draft, etc. Ills. 14400 w. Can Elec News—July 1, 1906. No. 78071.

Agricultural Show.

The Royal Agricultural Society's Show at Derby. Description and illustrations of exhibits of steam engines, and gas and oil engines are given in the present number. 3000 w. Engng—June 29, 1906. Serial. 1st part. No. 77895 A.

Boilers.

Some Essentials in Locomotive Boiler Design. D. Van Alstyne. Read before the N.-W. Ry. Club. Discusses points of importance in securing reliability and efficiency. General discussion. 3300 w. R R Gaz—July 20, 1906. No. 78059.

Water-Tube Boilers for Marine Service. William Ledyard Cathcart. A lecture before the Naval Archt. Soc. of the Mass. Inst. of Tech. Considers the effect of water-tube boilers on heat transmission, their requirements for marine service, gives details of construction of the Babcock & Wilcox marine boiler, tests, etc. Ills. 7500 w. Tech Qr—June, 1906. No. 78006 E.

Condensation.

Air in Relation to the Surface Condensation of Low-Pressure Steam. A report of experimental researches on the effect of gases—specifically atmospheric air—upon working efficiencies, showing that air should be rigorously excluded from high-grade surface-condensing installations. 4000 w. Engr, Lond—July 20, 1906. Serial. 1st part. No. 78322 A.

Efficiency.

Efficiency of Steam Plant. Walter A. Vignoles. Reports an investigation of the coal consumption in a central station, giving tests made, and discussing results. 4000 w. Mech Engr—June 23, 1906. No 77784 A.

Efficiency of Steam Plant. Walter A. Vignoles. Read before the Incor. Munic. Elec. Assn., London. An analysis of the coal and steam consumption of a central station, with a view to showing where the losses are incurred and how they can best be reduced. Also discussion which includes Mr. Wilkinson's paper. 8000 w. Elect'n, Lond—July 6, 1906. No. 77972 A.

Engines.

A New Vertical Steam Engine. George W. Heald. Illustrations and description of the special features of a new Bates engine. 1000 w. Engr, U S A—July 2, 1906. No. 77747 C.

High Power Steam Engines at Berlin. Illustrated description of engines and generators at the Moabit central station, Berlin, and at the Oberspree station. 1800 w. Engr, Lond—June 22, 1906. No. 77799 A.

Exhaust Steam.

The Rateau Exhaust-Steam Regeneration and Utilization Plant. An illustrated description of the plant installed at the Hallside Works of the Steel Co. of Scotland. 2200 w. Engng—June 29, 1906. No. 77893 A.

The Recovery of Power from Exhaust Steam (Kraftgewinnung aus Abdampf). Karl Rubricius. A discussion of various attempts to recover the energy rejected with the exhaust of steam engines with especial reference to the Rateau steam accumulator and low-pressure turbine. 4000 w. Elektrotechnik u Maschinenbau—June 24, 1906. No. 78170 D.

Feed Water.

Feed Water Heaters in Connection with Heating Systems. William G. Snow. Read at meeting of the Am. Soc. of Heat & Vent. Engrs. An illustrated article pointing out certain features in the application of feed water heaters in connection with heating systems. 2000 w. Met Work—July 21, 1906. No. 78048.

Live-Steam-Heated Feed Water—Its Effect on the Output and Efficiency of Steam Boilers. G. Wilkinson. Read before the Incor. Munic. Elec. Assn. Discusses the increasing the capacity of boilers designed for high duty, the range of temperature in boiler water, the methods of heating feed water, experimental work, etc. 9500 w. Elec Engr, Lond—June 29, 1906. Serial. 1st part. No. 77884 A.

Fire Boxes.

Firebox Steel—Failures and Specifications. Max H. Wickhorst. Abstract of a paper read at meeting of the Am. Soc. for Test. Mat. Discusses the conditions of failures, temperature tests, mud accumulations, and specifications. 2000 w. Ry Age—June 29, 1906. No. 77733.

Firing.

Mechanical Stoking Economics. A.

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S. Atkinson. Does not consider automatic stokers a gain in plants smaller than 2000 h.p. capacity. Discusses the skill in hand firing, and in the handling of automatic stokers. 2500 w. Engr, U S A—July 2, 1906. No. 77748 C.

Modern Improvements in Firing Methods (Neuere Erfahrungen in Feuerungs betrieben). A. Blezinger. Describing especially improvements in the production and use of gaseous fuel for heating and boiler furnaces. 4500 w. Stahl u Eisen—June 15, 1906. No. 78145 D.

Fuel.

Burning Low-Grade Fuel. James F. Hobart. Considers boiler firing with coal containing a large percentage of ash, slate and other incombustible matter. 3000 w. Elec Wld—July 7, 1906. No. 77870.

Crude Oil Burning at Eagle Mills, Newton, Mass. Percy H. Wayne. Describes briefly the mills and their equipment, and the Hammel device used for oil burning. Ills. 1400 w. Engr, U S A—July 16, 1906. No. 77994 C.

Liquid Fuel for Steam-Raising. A review of the recent report of the United States Naval Board on the series of tests carried out to determine the relative value of coal and liquid fuel for naval purposes. Considers only the liquid fuel results. Ills. 4000 w. Engng—July 20, 1906. No. 78306 A.

Liquid versus Coal Fuel. W. N. Best. A comparison, favoring liquid fuel. Ills. 1700 w. Sci Am Sup—July 7, 1906. No. 77828.

Lubrication.

Forced Lubrication in Engines of H. M. S. "Africa." Drawings and description of the forced lubrication system applied to the main propelling machinery of this vessel. 900 w. Engng—July 6, 1906. No. 77983 A.

Oiling Systems for Electric Engines. W. H. Wakeman. Illustrates and describes a number of systems. 1600 w. Elec Wld—July 7, 1906. No. 77869.

New Devices.

Notes from Abroad. E. Guarini. Illustrates and describes a new draft gage, new form of water gage, a leakage indicator, and other devices. 1000 w. Engr, U S A—July 16, 1906. No. 77996 C.

Steam Jackets.

Recent Experiments on the Efficiency of Steam Jackets (Der Nutzen des Dampfmantels nach Neueren Versuchen). A. Bantlin. A review of the experiments of Prof. D. S. Capper, forming the report to the Steam Engine Research Committee of the Institution of Civil Engineers. Serial. Part I. 3500 w. Zeitschr d Ver Deutscher Ing—July 7, 1906. No. 78112 D.

Steam Valve.

The Hopkinson-Ferranti Steam Valve. Illustrations, with description, of a radical departure in valve construction. The valve works upon the principle of converting the pressure of the fluid into velocity, and then reconverting the velocity into pressure again by means of a suitably formed nozzle. 1500 w. Engng—June 29, 1906. No. 77894 A.

Turbines.

Comparison between Pressure and Impulse Turbines (Vergleich der Druck und Ueberdruck-Dampfturbinen). Donat Banki. A mathematical computation showing that the loss of energy in the pressure turbine is 1.4 times that in the impulse turbine. 1200 w. Zeitschr d Ver Deutscher Ing—June 16, 1906. No. 78100 D.

Tests of a 500-Kilowatt Steam-Turbine Unit. Illustrated description of the turbine giving results of tests made by Prof. Schröter, of Munich. 1500 w. Engng—July 6, 1906. No. 77982 A.

The Steam Turbine. Charles Algernon Parsons and George Gerald Stoney. Reviews the early history, explaining the general theory and principles, and describing the Parsons, DeLaval and Curtis turbines. Gives results of trials and general discussion. Ills. 21500 w. Inst of Civ Engrs. No. 3548. No. 78018 N.

Steam Turbines. Sydney W. Baynes. Read before the Incor. Munic Assn. (Slightly abridged). Illustrates and describes most of the makes of steam turbines on the market. Discussion. 10700 w. Elect'n, Lond—June 22, 1906. No. 77781 A.

See also Electrical Engineering, Generating Stations.

MINING AND METALLURGY

COAL AND COKE.

Coalfields.

Theory of the Foundation and Occurrence of Coalfields. James Ford. Considers the coalfields were once vast swampy peat-bogs or masses of vegetation forming in standing water, and that the vegetation was mostly of small aquatic species. 3800 w. Ir & Coal Trds Rev—July 13, 1906. No. 78225 A.

Coal Washing.

The Henry Experiments in Coal Washing (Ingenieur Henrys Aufbereitungsversuche mit Kohlen). Julius Divis. Describing the experimental apparatus at the Hasard colliery, Micheroux, Belgium, for determining the best conditions for washing coal of various sizes. Two articles. 6000 w. Oesterr Zeitschr f Berg u Hüttenwesen—June 16, 23, 1906. No. 78149 each D.

Coke.

The Mechanical Handling of Hot Coke. George Frederick Zimmer. Deals with conveyors suitable for use in gas works, believing that larger conveyors of similar design may be adopted in coke-oven installations. Ills. 5000 w. Inst of Civ Engrs—No. 3568. No. 78023 N.

Colliery Equipment.

The Work of the Mining Engineer in Connection with the Construction and Equipment of Bituminous Collieries and Coke Plants. William Glyde Wilkins. On the requirements of the constructing mining engineer of today. 1500 w. Ind Wld—June 28, 1906. No. 77750.

Deep Mines.

Considerations on Deep Coal Mines. George Farmer. Abstract of a paper read at meeting of the Inst. of Min. Engrs., London. Discusses the physical difficulties encountered at great depths. 2000 w. Min Wld—July 7, 1906. No. 77850.

Illinois.

The Peabody Mines, Southern Illinois. R. S. Moss. A description of the Carterville seam, and especially of the No. 3 mine of the Peabody Coal Co., with illustrations. 900 w. Min Wld—July 21, 1906. No. 78089.

Philippines.

Philippine Coal Deposits. H. L. Wigmore. An illustrated article giving an account of diamond drilling in the Philippines and the development of the coal deposits of Batan Island. 7500 w. Mines & Min—July, 1906. No. 77905 C.

Russia.

The Coal and Carboniferous Deposits of Far Eastern Russia (Die Fossilen Kohlen und Kohlenstoffverbindungen des fernen Ostens Russlands). A. M. Ossendowsky. A tabulated report of the various coal, lignite, peat, and petroleum resources of Siberia, Manchuria, and Sakhalin, from a chemical viewpoint. Three articles. 8000 w. Oesterr Zeitschr f Berg u Hüttenwesen—June 23, 30, July 7, 1906. No. 78150 each D.

Spontaneous Ignition.

The Spontaneous Ignition of Coal. Vivian B. Lewes. Abstract of a lecture before the British Soc. of Arts. Considers the danger from this trouble when coal is stored in bulk, the means of preventing, and methods of extinguishing such fires. 1400 w. Eng & Min Jour—July 14, 1906. No. 77944.

Storage.

Ransom Coal-Storage Plant. Illustrates and describes a plant arranged for storing a half-million tons of coal and reloading it without hand work. 3000 w. Mines & Min—July, 1906. No. 77906 C.

Stripping.

Coal Mining by Open Stripping in Pennsylvania. F. W. Parsons. An illustrated article describing the method of working a coal seam in the Hazleton district. 1400 w. Eng & Min Jour—June 30, 1906. No. 77745.

Submarine Mines.

Submarine Coal Mining. Richard H. Brown. From *Jour. of the Min. Soc. of Nova Scotia.* Particulars connected with the operation of the largest of the six collieries of Cape Breton, now working under water. 1600 w. Min Rept—July 12, 1906. No. 77955.

Submerged Coal.

Submerged Salt-Water Storage for Coal. W. H. Beehler. Shows the dangers and losses caused by fires in coal stored in bulk, and urges the experiment of storing under salt water, giving information bearing on the subject. 4000 w. Pro U S Nav Inst—June, 1906. No. 78029 G.

United Kingdom.

The Coal Resources of the United Kingdom. J. L. Pultz. Notes from the final report of the Royal Commission on Coal Supplies, 1905. 1200 w. Eng & Min Jour—July 7, 1906. No. 77845.

COPPER.

Blast Furnaces.

The Washoe Plant of the Anaconda Copper-Mining Co. in 1905. L. S. Austin. Illustrated detailed description of the numerous departments of this extensive plant, the construction, operation, advantages, etc. 16000 w. Bul Am Inst of Min Engrs—July, 1906. No. 78250 D.

Electro-Metallurgy.

See Electrical Engineering, Electrochemistry.

Extraction.

Extraction of Copper from Pyrites Cinders or Poor Ore, with Direct Production of Sulphate of Copper from the Lixiviation Liquids. Carl Milberg. Translated from *Rassegna Mineraria.* Gives the main points of the process and the results. 2300 w. Min Jour—June 30, 1906. No. 77889 A.

Gribbell Island.

Gribbell Island—Its Geology and Mining Operations. W. M. Brewer. Information concerning this island, which is about 150 miles north of Vancouver Island. The development of two copper mining companies is described. 2500 w. B C Min Rec—June, 1906. No. 78085 B.

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Low-grade Ores.

Ely, Nevada. Arthur H. Halloran. A description of this region and the deposits of low-grade copper ores, the mine workings, etc. 2000 w. Min & Sci Pr—July 5, 1906. No. 77954.

Mount Lyell.

The Mount Lyell Copper Mine. S. A. Ionides. Illustrated description of this low-grade copper mine on the west coast of Tasmania, and the method of extraction. 1000 w Min & Sci Pr—June 30, 1906. No. 77858.

Refinery.

The Tacoma Copper Refinery. Day Allen Willey. Illustrated description of the plant and its operation. 500 w. Eng & Min Jour—July 28, 1906. No. 78280.

GOLD AND SILVER.

Australia.

Great Boulder Proprietary Gold Mine. Robert Allen. Illustrated description of the ore reduction plant and process of reduction. 2700 w. Min Jour—June 23, 1906. Serial. 1st part. No. 77786 A.

Kalgoorlie Revisited. Donald Clark. Remarks on the improvements in water supply, labor, methods of treatment, reduction in costs, etc. 3000 w. Aust Min Stand—June 6, 1906. No. 77874 B.

Power Generation and Costs at the Great Boulder Perseverance Mine, Western Australia. From the Monthly Journal of the Chamber of Mines of W. Australia. Detailed description of the power plant at this gold mine. 2000 w. Min Rept—June 28, 1906. No. 77739.

British Columbia.

Preliminary Report on the Rossland Mining District. R. W. Brock. A general review of investigations, giving the history, geology, topography, ore deposits, and mineral contents, methods of mining, processes of treatment, etc. copper, gold, silver and other minerals of value. Ills. Also editorial. 16800 w. B C Min Rec—June, 1906. No.. 78084 B.

Rossland Mining. Alfred W. Dyer. A report of progress and recent discoveries, and the copper-gold deposits. 1000 w. Can Min Rev—July, 1906. No. 78093 B.

The Eva Mine. Alfred W. Dyer. An illustrated account of a successful gold mine, developed under unfavorable conditions. 1200 w. Can Min Rev—July, 1906. No. 78092 B.

California.

Gold Mining in Siskiyou County, California. C. Godfrey Gunther. An account of methods applied in old placer fields that have been worked over by the early prospectors. 2000 w. Mines & Min—July, 1906. No. 77907 C.

Chile.

Some Silver-Bearing Veins of Caracoles, Chile. Gives a description of these deposits so far as explored. 1000 w. Min Jour—June 30, 1906. No. 77890 A.

Concentration.

Notes on the Treatment of Hard-Gangued Concentrating Ores. George Huston. Notes resulting from carefully studied practice designed to assist in laying out a flow sheet suitable for hard-gangued ores. 900 w. Min Rept—June 28, 1906. No. 77738.

Cyanide.

Cyanide Practice at the Liberty Bell Mill, Telluride, Colorado. W. E. Tracy. Illustrates and describes the methods of extraction used for a decomposed quartz ore containing a large amount of clay and talc. 900 w. Engr & Min Jour—July 28, 1906. No. 78281.

Mechanical Aids to the Cyanide Process. Illustrates and describes the Garvin machines for agitation and cyanidation of ore pulps, together with electro-deposition of the values from the cyanide solution. 1300 w. Min Rept—July 5, 1906. No. 77849.

Dredging.

Gold Dredging in the Urals, with Notes on Dredging in Siberia. William H. Shockley. An illustrated article giving data of gold-dredging in the Urals, and information regarding the country, labor, etc. 2000 w. Bul Am Inst of Min Engrs—July, 1906. No. 78253.

Galena.

The Daly-West Mine, Park City, Utah. An illustrated description of this silver-lead mine and the methods of working. 2200 w. Eng & Min Jour—July 7, 1906. No. 77843.

Gold.

The Gold in the World and its Extraction (L'Or dans le Monde et son Extraction). L. de Launay. A review of the statistics of recent gold production in various parts of the world, with some account of the geology, and of the methods of extraction leading to the present greatly increased production. Two articles. 12000 w. Rev Gen d Sciences—June 15. 30, 1906. No. 78184 each D.

Low-Grade Ore.

New Sources of Gold. Waldon Fawcett. An illustrated description of the concentrating machines under trial by the U. S. Government for handling low-grade gold deposits, and for the investigation of the "black sand." 1500 w. Sci Am—July 21, 1906. No. 78063.

Nevada.

The Stamp Mill and Cyanide Plant of the Combination Mines Company at Goldfield, Nevada. Mark R. Lamb. Illustrated detailed description of the equipment and working of a mill for the extraction of gold and silver. 1600 w. Eng & Min Jour—June 30, 1906. No. 77744.

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Ontario.

The Cobalt Mining District. W. M. Courtis. Information of interest concerning this district, the richness of the ore, masses of native silver, cobalt, nickel, bismuth, arsenic and a little gold are found. Ills. 1300 w. Eng & Min Jour—July 7, 1906. No. 77842.

Ore Reduction.

The Francke-Tina Process for the Reduction of Silver Ores, as Carried on at Caylloma, Peru. Alfred Fox. Gives a description of the working of this process, which is said to be very expensive. Ills. 2800 w. Inst of Civ Engrs—No. 3571. No. 78024 N.

Placers.

Development of Placer Gold Mining in the Klondike District, Canada. J. B. Tyrrel. Abstract of a paper read before the Inst. of Min Engrs. Calls attention to the difficulties encountered, the plans successfully adopted to overcome them, and the constantly reduced cost of mining. The method of steam-thawing is described. 2000 w. Ir & Coal Trds Rev—June 22, 1906. No.77789 A.

Prospecting.

Prospecting a Gold Placer. A description of the machinery used and methods of operating and of calculating values from the results. Ill 3000 w. Mines & Min—July, 1906. No. 77911 C.

Pyrite.

The Relations Between Gold and Pyrite. Henry Lloyd Smyth. Gives a brief account of an occurrence of gold, showing an important distinction to the miner, between the two varieties of pyrite. 1000 w. Min & Sci Pr—July 14, 1906. No. 78200.

Tonopah.

Tonopah, Nevada. Claude T. Rice. An illustrated account of present conditions at this important silver mine, with brief description of the geology of the region. 2200 w. Eng & Min Jour—July 21, 1906. Serial. 1st part. No. 78082.

IRON AND STEEL.

Blast Furnaces.

A Simple Rotary Distributor for Blast Furnace Charges. David Baker. Illustrates and describes a design which may be applied to any form of double-bell charger, retaining the perfect gas-seal. 1000 w. Bul Am Inst of Min Engrs—July, 1906. No. 78249.

The Blast-Furnace Plant of the Federal Furnace Company. Plans and description of the blast furnace plant and ore storage yard of this company at South Chicago, Ill. 2500 w. Ir Age—July 19, 1906. No. 78012.

The Gas-Producer as an Auxiliary in Iron Blast-Furnace Practice. R. H. Lee. Presents the advantages of a gas-producer driven by forced blast as a means of supplying additional blast when needed. 1600 w. Bul Am Inst of Min Engrs—July, 1906. No. 78251 D.

The Heat Balance Sheet of the Blast Furnace. J. W. Richards. A treatment of this subject based on the researches of Sir Lothian Bell, illustrating by problems. 5000 w. Elec-Chem & Met Ind—July, 1906. No. 77914 C.

The Northern Iron Company's Blast Furnace. J. H. Granbery. An illustrated description of this furnace plant at Port Henry, N. Y., with a review of its interesting features. 2000 w. Eng & Min Jour—July 21, 1906. No. 78081.

Cast Iron.

See Mechanical Engineering, Materials.

Dry-Air Blast.

The Dry Blast Question (Zur Frage der Windtrocknung). B. Osann. A review of the later results obtained by the use of the Gayley dry-air blast, with comments. Serial. Part I. 3000 w. Stahl u Eisen—July 1, 1906. No. 78147 D.

Electric Smelting.

See Electrical Engineering, Electrochemistry.

Extensions.

Additions to the Illinois Steel Co.'s Plant. Plans and description of a new universal plate mill, and a rail mill, both to be electrically driven. 1500 w. Ir Trd Rev—July 5, 1906. No. 77806.

Gas Power.

Gas Blowing Engine Plant of the Indiana Steel Co. Illustrated description of machinery similar to that which is to supply the large plant at Gary, Indiana. 2800 w. Ir Trd Rev—July 26, 1906. No. 78260.

India.

Iron and Steel Manufacture in India. An account of conditions relating to iron and steel manufacture in India, and of a proposed plant for an organization to be known as the Tata Iron & Steel Co., Ltd. Ills. 3000 w. Ir Age—July 12, 1906. No. 77903.

Overstrain.

Effect of Low Temperature on the Recovery of Steel from Overstrain. E. J. McCaustland. Supplementary diagrammatic charts, showing the results of the heat-treatment of Specimens Nos. 1 to 12 to accompany a paper published in the May Bulletin, 1906. Bul Am Inst of Min Engrs—July, 1906. No. 78254.

Pig Iron.

See Mechanical Engineering, Materials.

Rolling.

Improvements in Rolling Iron and Steel. James E. York. Read at joint meeting of the Ir. & St. Inst. and Am. Inst. of Min. Engrs., London. Explains the difficulties which led to the design-

ing of the York universal mill, describing the mill and discussing its advantages. 4000 w. Ir Age—July 26, 1906. No. 78227.

Rolling Mill.

The Jones & Laughlin Steel Company's New Structural Mill. Illustrated detailed description of a new mill recently completed at Pittsburgh. 2000 w. Ir Age—July 5, 1906. No. 77770.

Segregation.

Segregation in Steel Ingots. Charles L. Huston. Read at meeting of the Am. Soc. of Test. Mat. Presents the results of tensile tests and carbon analyses from plates, showing how the steel varies throughout the different parts of the ingots. Ills. 2500 w. Ir Age—July 5, 1906. No. 77769.

Variations in Strength of Rolled Steel Plates Due to Segregation of Carbon. A review of a recent paper by Charles L. Huston on "Experiments on the Segregation of Steel Ingots in Its Relation to Plate Specifications." Ills. 2500 w. Eng News—July 26, 1906. No. 78232.

MINING.

Caving System.

The Caving System of Mining. W. H. Storms. Discusses the mining of low-grade ores, explaining the caving system, and its successful operation, describing its application at the Pewabic mine at Iron Mountain, Mich. 2000 w. Min & Sci Pr—July 14, 1906. No. 78097.

Electric Power.

Electricity in Mining (L'Electricité dans les Mines). Maurice Orban. A very complete description of the generating station and electrical equipment of the Hasard mines near Fleron, Belgium. Two articles. 7000 w. Soc Belge d'Electriciens—May, June, 1906. No. 78189, each F

Mining and Milling by Electric Power Machinery. Charles V. Allen. The first installment, with numerous illustrations of the application of electric power to mining operations. 3500 w. Engineering Magazine—August, 1906 .No. 78193 B.

Notes on the Introduction of Electric Power into Large Coal Mining Plants (Einige Gesichtspunkle für die Errichchtung Elektrischer Antagen auf Grosseren Steinkohlenberguierken). General suggestions as to prime movers, choice of current, switchboard arrangement, and working details; by the Dortmund Boiler Inspection Association. 4000 w. Glückauf—June 30, 1906. No. 78154 D.

Fire.

Fire Fighting with Continuous Ventilation in Gaseous Mines (Grubenbrandgewältigung bei Unzulässiger Ventilation in Gasreichen Kohlengruben). Johann Mayer. The miners are provided with suits and helmets supplied with air through hose connected to a central supply . 1500 w. 1 plate. Oesterr Zeitschr f Berg u Hüttenwesen —July 7, 1906. No. 78152 D.

Filling.

Conveying Filling Material by Water (Le Remblayage par l'Eau). H. Schmerber. Describing the use of flowing water in pipes as a means of conveying rock or other filling material into disused workings. Examples from various mines are given. Two articles. 5000 w. Génie Civil—May 26, June 2, 1906. No. 78118, each D.

Haulage.

A Rateau Exhaust Steam-Driven Three-Phase Haulage Plant. William Maurice. Abstract of paper read before the Inst. of Min. Engrs. Introductory remarks with a description of a Rateau installation to supply power for underground haulage. 2000 w. Ir & Coal Trds Rev—June 22, 1906. No. 77788 A.

Head-Frame.

The Leonard Head-Frame. A. H. Halloran. Illustration, with brief description of the new head-frame recently erected at the Leonard shaft of the Boston & Montana Copper Mining Co., which embodies the most modern ideas in steel construction. 500 w. Min & Sci Pr—June 30, 1906. No. 77856.

Korea.

Mining in Korea. J. H. Curle. An illustrated account of mining conditions, labor, etc., principally relating to gold mining. 1700 w. Min & Sci Pr—July 21, 1906. No. 78284.

Milling.

Milling Practice at the North Star Mine, Nevada County, California. G. E. Alexander. An illustrated description of the unusual features of the mill, and of the electric precipitation, and other applications of electric power. 1400 w. Min Rept—July 19, 1906. No. 78090.

Ore Milling in Wisconsin. Illustrates and describes the milling practice used in the zinc-lead district. The wet concentrating, and the magnetic separation processes are described. 1800 w. Eng & Min Jour—July 28, 1906. No. 78282.

Mine Power.

The Distribution of Power on Mines. Contribution to the discussion of the paper by C. E. Hutton. A. E. Payne describes a system of apportionment of charges under power account at the mine of the new Primrose G. M. Co., Ltd. 1000 w. Jour S African Assn of Engrs—May, 1906. No. 77775 F.

Mine Surveying.

The Qualifications of a Mine Surveyor. Henry Briggs. Discusses the methods in England as compared with the United States and Germany, urging

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an improvement, and outlining the methods now being taught. 1600 w. Col Guard—July 6, 1906. No. 77977 A.

Mine Ventilation.

Electrically-Operated Ventilating Plant in Northberg Pit, Germany. Alfred Gradenwitz. Illustrates and describes an arrangement to utilize the advantages of alternating currents in the transmission of energy. 1700 w. Eng & Min Jour—July 14, 1906. No. 77943.

Mining Locomotives.

Electric Mining Locomotives in Great Britain. J. F. Gairns. Illustrated description of types employed in British practice. 800 w. Eng & Min Jour—July 7, 1906. No. 77844.

Mining Methods.

Methods of Mining, Hauling, and Screening at the Mines of the Aldrich Mining Company, at Brilliant, Alabama. T. H. Aldrich, Jr. States the conditions of the problem to be met and the solution. 6000 w. Bul Am Inst of Min Engrs—July, 1906. No. 78252 C.

Operation.

Some General Principles Governing the Operation of Mines. J. R. Finlay. General remarks with a division of mines into three classes, giving a scheme of cost-keeping, and stating the general principles claimed. 1600 w. Min & Sci Pr—July 21, 1906. No. 78285.

Peru.

The Mineral Resources of Peru. A. L. M. Gottschalk. Information concerning the variety of minerals of commercial value to be found. Alabaster, marble, cobalt, lead, mica, molybdenite, nickel, petroleum, salt, silver, gold, coal, etc. 3000 w. Min Wld—July 28, 1906. No. 78288.

Pumping.

Mine Pumping by Compressed Air. A. M. Patterson, Jr. Abstract of a paper read at Pittsburg meeting of the Coal Mining Inst. of America. Brief discussion of the four approved methods of pumping with compressed air as applied to mine use. 2200 w. Min Wld—June 30, 1906. No. 77717.

Rescue Apparatus.

A New Apparatus for Rescue Work in Mines. W. E. Garforth. Abstract of paper read before the Inst. of Min. Engrs. Discusses the requirements of rescue apparatus, and the efforts made to furnish such apparatus, the defects, etc., describing an apparatus designed by the writer. 2500 w. Ir & Coal Trds Rev—June 22, 1906. No. 77787 A.

The "Pneumatogen Rescue Apparatus for Mines. Richard Cramer. Illustrated description of this apparatus. The most essential part is a filter in which potassium-sodium peroxide constitutes the filtering material. 1400 w. Ir & Coal Trds Rev—July 6, 1906. No. 77992 A.

The Shamrock Rescue Apparatus at the Courrières Collieries. G. A. Meyer. Read before the Inst. of Min. Engrs. Reviews the development of portable apparatus for the breathing of oxygen, especially considering the latest results. Also editorial. Ills. Min Jour—June 23, 1906. Serial. 1st part. No. 77785 A.

Roasting.

A Novel Furnace for Roasting Fine Ore. Dr. Alfred Gradenwitz. Illustrated description of a furnace designed by G. O. Peterson, of Finland, and of its operation. 700 w. Ir Trd Rev—July 19, 1906. No. 78050.

Safety Appliances.

Safety Appliances for Electrical Apparatus in Coal Mines. Editorial on the researches carried out in the Westphalian district of Germany showing that electric machinery can be rendered safe in fiery mines without undue complications and at reasonable cost. 3000 w. Engng—July 20, 1906. No. 78312 A.

Shafts.

Concrete Lining for Mine Shafts. Carl Henrich. Describes the writer's views of the easiest and best way of putting in the concrete, and gives a comparison of costs of concrete lining and timbering. 1700 w. Min Wld—July 28, 1906. No. 78286.

How Bodies Fall in Deep Vertical Shafts. F. W. McNair. An explanation of some of the causes that deviate a falling object from the vertical, and reporting an investigation made at No. 5 shaft in the Tamarack mine. 2000 w. Min & Sci Pr—July 14, 1906. No. 78099.

The Deepening of the Julins Shaft at the La Houve Mine in Lorraine (Das Abteufen des Schachtes Julius der Bergwerks-Aktiengesellschaft La Houve bei Kreuzwald in Lothringen). H. Wewetzer. Describing the application of the Kind-Chaudron method for sinking a shaft through sand, clay, and water-bearing strata. 2000 w. Gluckauf—June 23, 1906. No. 78153 D.

Sieves.

Sieve and Screen Aperatures. George T. Holloway. Abstract from Bul. No. 5 of the Inst. of Min & Met. Gives tables showing the size of aperature obtainable with sieves of different mesh with wire of different gauge, and discusses the advisability of deciding upon some general standard. 1500 w. Min Wld—July 21, 1906. No. 78088.

Sketching.

Mining Sketching. Prof. Arthur Lakes. Illustrates and describes methods of drawing various kinds of timbering

We supply copies of these articles. See page 995.

and showing the appearance of different openings and passages underground. 1800 w. Mines & Min—July, 1906. No. 77910 C.

Smelting.

The Imbert Process. E. Gibbon Spilsbury. Describes a process for the extraction of certain metals from their sulphides. 1800 w. Min & Sci Pr—June 30, 1906. No. 77857.

Tonopah.

The Tonopah Volcanoes. Prof. Arthur Lakes. Discusses the causes to which are due the appearance of the country and also the ore deposits. 700 w. Mines & Min—July, 1906. No. 77908 C.

Turkey.

Coal, Iron Ore, and Manganese in Asiatic Turkey. Bruno Simmersbach in *Zeitschrift fur Berg-Hutten-und Salincnwesen.* Information concerning the deposits and the development of this region. 2000 w. Ir & Coal Trds Rev—July 6, 1906. No. 77991 A.

Winding.

Duplex Tandem Winding-Engine. Illustrated description of a large horizontal duplex tandem winding engine made at Erith, stating the conditions it was constructed to fulfil. 2200 w. Engng—July 20, 1906. No. 78310 A.

Mine Winding-Engines. Illustrates and describes the important features of three different types of winding engines showing present practice. 2000 w. Engng—June 22, 1906. No. 77793 A.

The Westinghouse Converter Equalizer System for Variable Loads (Winding motors, rolling mills, etc.). Briefly describes and illustrates this system. 2000 w. Ir & Coal Trds Rev—June 22, 1906. No. 77792 A.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION.

Accidents.

The Salisbury Railway Accident. An illustrated account of the accident to the boat-train express on the South-Western Railway, England. 2000 w. Engng—July 6, 1906. No. 77984 A.

Clearing House.

The Railway Clearing House. A brief account of this institution and its functions. 3500 w. Engr, Lond—July 6, 1906. No. 77987 A.

Cost.

Cost per Mile Run. J. E. Goodman. Extract from address to the Northern Ry. Club, on the subject of locomotive repairs. 600 w. Ry & Loc Engng—July, 1906. No. 77864 C.

Difficult Feat.

A Difficult Railroad Transportation Feat. Illustrations, with brief account of the transportation of the very large castings of the "Lusitania." 400 w. Sci Am Sup—July 7, 1906. No. 77827.

Train Control.

The Raymond Phillips System of Train-Control. Brief illustrated description of this automatic train-control system. 1000 w. Engng—July 13, 1906. No. 78219 A.

MOTIVE POWER AND EQUIPMENT.

Cars.

New Third-Class Cars for the Midi Railway of France (Les Nouvelles Voitures de Troisième Classe de la Compagnie des Chemins de Fer du Midi). Francis Marre. Illustrating a new corridor carriage, for 66 third-class passengers. The design includes improved heating, lighting, and toilet arrangements. 1000 w. 1 plate. Génie Civil—May 19, 1906. No. 78116 D.

Electric Locomotives.

Electric Locomotive Tests on the Seebach-Wettingen Railway. Frank C. Perkins. Brief account of the tests, with illustrations. 1100 w. Ry & Engng Rev—July 14, 1906. No. 77958.

Electrification.

Electric Traction on the Lancashire and Yorkshire Railway. An illustrated account of new lines to be electrified, or already in service. Maps. 3000 w. Elec Engr, Lond—July 6, 1906. No. 77960 A.

Hammersmith and City Railway Electrification. Principally an illustrated description of the Park Royal power-station of the Great Western Railway. 6800 w. Tram & Ry Wld—July 12, 1906. No. 78212 B.

The Electrical Equipment of the Great Western Railway. An illustrated detailed description of the plan of generating stations and distribution. 6000 w. Elect'n, Lond—June 22, 29, 1906. Serial—2 parts. No. 77887 each A.

Front Ends.

Locomotive Front Ends. The report submitted by the committee appointed by the Master Mechanics Assn. 3000 w. Ry & Loc Engng—July, 1906. No. 77865 C.

Indicators.

Locomotive Tachographs. Illustrates and describes types of speed indicators for automatically registering the speed of trains, discussing their advantages. 1800 w. Engr, Lond—July 13, 1906. No. 78221 A.

We supply copies of these articles. See page 995.

Locomotive Frames.

Welding Locomotive Frames. Extracts from a paper by R. P. C. Sanderson, before the M. M. Assn. Report of the writer's experiences in learning to use Thermit successfully. 2200 w. R R Gaz—July 13, 1906. No. 77950.

Locomotives.

American Experience with Compound Locomotives. Remarks on the railways using large numbers of compounds and their service. 1700 w. Engr, Lond—July 20, 1906. No. 78314 A.

An Interesting Locomotive Conversion. Illustrations showing the changes made in reconstructing a three-cylinder compound (Webb's system) 0-8-0 type mineral locomotive to a simple engine. 1400 w. Mech Engr—June 23, 1906. No. 77782 A.

Baldwin Locomotives for the Union Pacific and Great Northern Railways. Illustrated descriptions of two locomotives exhibited at Atlantic City during the recent convention of the Am. Ry. Mas. Mech's Assn. 1100 w. Ry Age—July 20, 1906. No. 78095.

Baltimore & Ohio Railroad Motive Power. Illustrates and describes the latest addition to the locomotive equipment, consisting of some very heavy and powerful Pacific type engines. 1500 w. Am Engr & R R Jour—July, 1906. No. 77760 C.

Lake Champlain & Moriah 2-8-2. Illustrated description of an engine designed to work on 4° grades and to pass around 14 deg. curves. 800 w. Ry & Loc Engng—July, 1906. No. 77863 C.

Locomotive for the Hungarian State Railways. Illustrated description of a four-cylinder compound, four-coupled wheel, 4-4-2 type engine shown at the Milan Exhibition. 1300 w. Engng—July 20, 1906. No. 78309 A.

Locomotive Improvements: L. & N. W. Railway. Charles S. Lake. Considers alterations made in types of locomotives, raising the boiler power, adding extra wheels, etc. 1000 w. Mech Engr—July 21, 1906. No. 78303 A.

Mogul Locomotives for the Panama Excavation. Illustrates and describes two designs to be used in the construction of the Panama Canal. 120 have recently been completed. 800 w. R R Gaz—July 20, 1906. No. 78056.

Mountain Climber in Upper Burma. Brief illustrated description of en engine used on the Darjiling-Himalayan railway, a narrow gauge road 24 ins. wide. 400 w. Ry & Loc Engng—July, 1906. No. 77866 C.

New Locomotives for Mixed Driving on the Brünig Railway (Neue Lokomotiven der Brünigbahn für Gemischten Betrieb). Illustrating four-cylinder compound engines for adhesion and rack-railway service on the railway over the Brünig pass, in Switzerland. 1200 w. Schweiz Bauzeitung—June 16, 1906. No. 78140 B.

Pittsburg and Lake Erie Switching Locomotive. Illustrated description of a type of engine for use in the gravity yards to push heavy trains up the "hump." 700 w. Ry Age—July 27, 1906. No. 78292.

Rack Locomotive for Manitou and Pike's Peak Railway. Illustrated description of some new engines for this road, which is operated on the Abt rack-rail system, with a maximum grade of 25 per cent. 700 w. R R Gaz—July 13, 1906. No. 77949.

Recent de Glehn System Compound Locomotives. Illustrations and particulars of recent types of engines, compounded on the de Glehn system, and supplied to French and German railways. 1600 w. Mech Engr—July 14, 1906. No. 78207 A.

Simple Consolidation Locomotive with Walschaert Valve Gear. Illustrated description of a new design for the L. S. & M. S. R. R. 700 w. Am Engr & R R Jour—July, 1906. No. 77761 C.

Six-Coupled Passenger Express Locomotive; Caledonian Railway. Illustrated description of engines especially built for the Grampian express service. 800 w. Engng—June 22, 1906. No. 77796 A.

Motor Car.

Steam Motor Car for the Canadian Pacific. Illustrated description of an oil-burning steam motor car in service on this line. 600 w. R R Gaz—July 20, 1906. No. 78055.

Train Lighting.

The Electric Lighting of Railway Trains on the L'Hoest-Piper System. G. L'Hoest. Describes this system in which a single generating set is employed which provides the electric energy required for the whole train, the current being distributed to the vehicles in series. Ills. 4800 w. Bul Int Ry Cong—June, 1906. No. 78035 E.

Train Resistance.

The Tractive Resistance of Railway Trains (Ueber die Zugwiderstande der Eisenbahnfahrzeuge). P. Denninghoff. An examination of the various formulas for train resistance, with curves showing the resistances due to wind, friction, and load; with suggestions as to improved forms of cars. 5000 w. Glasers Annalen—June 15, 1906. No. 78142 D.

NEW PROJECTS.

Canada.

Canadian Railroad Expansion. S. J. M'Lean. Concerning projected lines and the development of the railroad systems of Canada, and the interests which they serve. 4000 w. R R Gaz—July 6, 1906. No. 77814.

We supply copies of these articles. See page 995.

China.

The Pekin-Hankow Railway in China. P. H. Ashmead. Map and illustrated description of the line and its equipment, with information of interest. 3000 w. Eng News—July 12, 1906. No. 77923.

Extensions.

Lancashire and Yorkshire Railway. An illustrated detailed description of the new equipment and extensions of the Liverpool and Southport electric line. 4000 w. Tram & Ry Wld—July 12, 1906. No. 78211 B.

New Line.

The Opening of the Great Western's New Main Line. Charles Rous-Marten. Information concerning the opening of a line connecting London with Exeter, Plymouth, and the far west, with particulars of its rolling-stock, operation, etc. 3300 w. Engr, Lond—July 6, 1906. No. 77989 A.

Tehuantepec.

The Tehuantepec Railway and the Harbors at Its Ocean Terminals. An illustrated detailed description, with information of interest. 2000 w. Eng News—July 5, 1906. No. 77816.

PERMANENT WAY AND BUILDINGS.

Amsterdam.

Plan for the Improvement of the Railway Connections at Amsterdam (Ontwerp-Verbetering der Spoorwegverbindingen om Amsterdam). N. W. Nierstrasz. A long report to the Institute of Engineers with plans for a new terminal, a ring railway, and extended facilities. 10000 w. 2 plates. De Ingenieur—April 14, 1906. No. 78181 D.

Culvert.

A Low-Cost Concrete Culvert. W. H. Whorley. Read before the Engng. Assn. of the South. Describes a 12-ft. full-centered concrete arch culvert with 6-ft. side walls constructed on the Nashville, Chattanooga and St. Louis Ry. Gives tables of cost of concrete structures. 1200 w. Eng News—July 5, 1906. No. 77818.

Interlocking.

Power Interlocking Plants in Great Britain and on the Continent. Considers the methods of operating railway switches and signals by power. 2000 w. Ry Age—June 29, 1906. No. 77734.

Mountain Roads.

The Design of Rack Railways (Les Chemins de Fer à Crémaillère). A. Levy-Lambert. A very complete review of the various types of rack railways and locomotives, as used on steep grades in mountainous districts in Europe and America. 15000 w. Mem Soc Ing Civ de France—March, 1906. No. 78139 G.

Power Plant.

Power Plant in the Silvis Shops of the Rock Island System. O. Monnett. Illustrated detailed description of a power house distributing electric power, compressed air, hydraulic power, live steam, exhaust steam, service water, hot water and drinking water. 3000 w. Engr, U S A—July 2, 1906. No. 77746 C.

Rails.

Rail Corrugation. F. T. Aman. A report of an investigation of such rails by means of the microscope and camera. Ills. 1000 w. Tram & Ry Wld—July 12, 1906. No. 78213 B.

Reconstruction.

Big Four Reconstruction, Indianapolis to Coal Bluff. Illustrates and describes some of the heaviest work undertaken in carrying forward betterments of this road. 59 miles of double track replace existing single track, and 20 miles of cut-off. 2000 w. Ry Age—July 6, 1906. No. 77853.

Rebuilding the Highland Division of the New York, New Haven & Hartford. An explanation of the new lines recently acquired by the N. Y., N. H. & H. R. R. and the work undertaken to prepare the lines for modern traffic, especially the double-tracking of the line from Hopewell, N. Y., to Danbury, Conn. Ills. 2500 w. R R Gaz—July 13, 1906. No. 77947.

Signaling.

Combined Manual and Automatic Block Signaling on the C., N. O. & T. P. An explanation of the operations of the system near Danville, Ky., where a single track is signaled by the controlled manual system for opposing trains and by track circuit signals for following trains. 1000 w. R R Gaz—July 27, 1906. No. 78265.

Electric Signaling on English Railroads. A report of the progress of the electrification of signals in England, and the cause of the delay. Ills. 1600 w. Elec Engr, Lond—June 29, 1906. Serial. 1st part. No. 77885 A.

The Use of Electric Currents with Isolated Rails for the Control of Trains (Over Stroomketens met Geisoleerde Rails ter Beveiliging van den Loop der Treinen). J. D. C. M. de Roos. A study of electric signalling for single and double track railways. 12000 w. Tijdschr van het Kljk Inst van Ingenieurs—Feb. 3, 1906. No. 78187 H.

Station.

New Passenger Station for the B. & O. R. R. at Wheeling, W. Va. An illustrated description of a fireproof structure having three stories and attic, but no basement, as the location is such that it would be flooded during high water. 1000 w. Ry & Engng Rev—July 7, 1906. No. 77855.

The Enlargement of Victoria Station. Begins an illustrated detailed description of this reconstructed and greatly enlarged station on the London, Brighton, and South Coast Railway. 5000 w. Engng—July 13, 1906. Serial. 1st part. No. 78215 A.

We supply copies of these articles. See page 995.

Steep Grades.

The Lake Champlain & Moriah Railroad. J. H. Granbery. Map and description of this line with illustrated account of an unusual accident causing the wreck of a locomotive and seven ore cars. 1400 w. Eng & Min Jour—June 30, 1906. No. 77742.

Ties.

The Carnegie Steel Tie. An illustrated article explaining results obtained by the use of steel ties and giving information relating to them. 1000 w. R R Gaz—July 20, 1906. No. 78058.

Warehouse.

A Large Railway Freight House and Warehouse at Pittsburg, Pa. A warehouse and freight station which provides numerous private rooms for independent firms, is illustrated and described in detail. 3500 w. Eng News—July 19, 1906. No. 78067.

TRAFFIC.

Car Service.

Division of Foreign Cars—Remedies Suggested. J. W. Midgley. Considers instances of unfair division, the causes, and remedies. 3000 w. Ry Age—July 27, 1906. No. 78291.

Weak Points in the Car Service Rules and the per Diem Code. J. W. Midgley. A discussion of certain points showing the conditions and need of remedy. 3800 w. Ry Age—July 20, 1906. No. 78096.

MISCELLANY.

Address.

Address of President Ball to the Master Mechanics Association. Discusses progress and improvements of the last ten years, the motive power problem, and other topics of interest. 4500 w. Am Engr & R R Jour—July, 1906. No. 77759 C.

Mortgages.

Types of Railroad Mortgages. Thomas W. Mitchell, in the *Journal of Accountancy*. An explanation of the various types of mortgages and the purposes they serve. 3500 w. R R Gaz—July 6, 1906. No. 77812.

Organization.

Organization of the Pennsylvania Railroad, 1906. An abstract made from comments in a paper by A. J. County, on the division of responsibility throughout the system. 4000 w. R R Gaz—July 13, 1906. No. 77948.

Siberia.

A Lost Railroad. L. Lodian. Relates an interesting historic incident in the construction of the Trans-Siberian railway. 2500 w. Elec Rev, N Y—June 30, 1906. No. 77737.

Supplies.

Testing and Inspection of Railroad Supplies. Robert Job. Gives an outline of some of the important test work carried out regularly on the Philadelphia & Reading Railway. 2000 w. Jr Fr Inst—July, 1906. No. 78009 D.

STREET AND ELECTRIC RAILWAYS

Brakes.

Brake-Rigging and Uneven Wear of Brake-Shoes. W. L. Boyer. Calls attention to faults in design and the conditions responsible for many of the troubles. Ills. 4000 w. St Ry Jour—July 21, 1906. No. 78073 C.

Chicago.

The Status of the Chicago Traction Problem. Louis Albert Lamb. Discusses the "99-years" claims of the Chicago street railways, and the result of the decision of the United States supreme court. 3300 w. Elec Ry Rev—July, 1906. No. 77966.

Elevated Railway.

A Proposed Elevated Railway of 1827. Illustrates an elevated double track railway shown in an old pamphlet issued in 1827 by John Langdon Sullivan, giving the advantages claimed. 1000 w. Eng News—July 19, 1906. No. 78069.

Improvements.

Improvements and Operating Features of the Southwest Missouri Electric Railway. Describes the extensions and track work, the new line, new cars, etc., and the system of operation. 4000 w. St Ry Jour—July 21, 1906. No. 78072 C.

Improvements on the St. Louis and Suburban Railway. An illustrated article describing reconstruction and double tracking, the erection of a new substation, etc. 1500 w. St Ry Jour—June 30, 1906. No. 77728 C.

Incline.

A Cable Incline Railway with Endless Cable. The Bernardit system adopted at Nancy, France, is illustrated and described. 1000 w. Eng News—July 12, 1906. No. 77926

Milwaukee.

Commerce Street Power Plant of the Milwaukee Electric Railway and Light Company. Illustrated description of the plant which supplies practically all the current required to operate the extensive street and interurban railway system. 5500 w. St Ry Jour—July 28, 1906. No. 78278 C.

We supply copies of these articles. See page 995.

The New Public Service Building of the Milwaukee Electric Railway and Light Company. Illustrated detailed description of a building which combines a terminal station for interurban service, and an office building devoted to the needs of the company. 6000 w. St Ry Jour—July 14, 1906. No. 77932 C.

Power.

Power Supply to Tramway Systems. S. J. Watson. Read before the Incor. Munic. Elec. Assn., London. The subject applies only to small or medium-sized districts operating from 6 to 30 cars. Discusses whether the supply can be best given by storage batteries and a reversible booster, or run directly on the traction load. 5000 w. Elect'n, Lond—July 6, 1906. No. 77973 A.

Power Plant.

The Commerce Street Power Plant of the Milwaukee Electric Railway & Light Company. Illustrated description of the changes which have more than doubled the capacity of the plant. 2800 w. Elec Ry Rev—July, 1906. No. 77965.

Rail Joints.

Rail Joints for Electric Street Railways (Die Stossverbindung der Rillenschienen Elektrischer Strassenbahnen). Max Buchwald. Illustrations of various forms of German rail joints, and of a portable milling machine for finishing the surfaces. 3000 w. Elektrotech Zeitschr—June 28, 1906. No. 78165 B.

Rapid Transit.

Rapid Transit in Chicago. A report submitted by Bion J. Arnold to the Committee on Local Transportation of the Chicago City Council, July 2, 1906. Recommendations as to what to do at present. Map. 2800 w. R R Gaz—July 13, 1906. No. 77951.

The 60,000-Volt Sub-Station and Transmission Line of the Syracuse Rapid Transit Company. An account of the transmitting of a 60,000-volt current generated at Niagara Falls, 165 miles to Syracuse, to be utilized for operating the traction system of the city. 4500 w. St Ry Jour—July 14, 1906. No. 77933 C.

Shops.

The New Car House and Remodeled Shops of the International Railway Company, Buffalo, N. Y. Illustrates and describes recent improvements in the car-house and shop facilities at the Cold Springs depot. 4500 w. St Ry Jour—July 7, 1906. No. 77847 C.

Signalling.

Some Recent Block Signal Systems for Electric Railways. Gives particulars of some systems which have been put in service, with diagrams. 3500 w. Eng News—July 19, 1906. No. 78070.

Single Phase.

The Finzi Single-Phase Railway System (La Ferrovia Monofase Sistema Finzi). A brief description, with sheet of illustrations of the Finzi system of monophase electric traction, as exhibited at Milan. 1200 w. 1 plate. L'Industria—April 29, 1906. No. 78177 D.

Snow.

Methods of Handling Snow on Electric Railways. Gives particulars as to methods and equipments employed by a number of interurban railways in different parts of the United States. Ills. 4500 w. Eng News—July 26, 1906. No. 78234.

Station.

Commonwealth Electric Company's New Station. An illustrated detailed description of the first steam turbine generating station in Chicago. 4000 w. Ir Age—July 20, 1906. No. 78226.

Park Royal Power Station and the Hammersmith and City Electric Railway. Detailed description of the new generating station of the Great Western Ry. Co., and the lines which it serves. 3500 w. Elec Rev, Lond—June 22, 1906. Serial. 1st part. No. 77778 A.

Subways.

Station Locations in the Washington Street Tunnel, Boston. Map, plans, and description of the Washington Street tunnel and platforms. 1000 w. Ry Age—July 27, 1906. No. 78289.

Test Commission.

Electric Railway Test Commission. Henry V. Norris and Bernard V. Swanson. An analysis of the work by this commission, discussing its organization, the investigations and deductions. 2800 w. Elec Ry Rev—July, 1906. No. 77964.

Traction.

Electric Traction at 2400 Volts (Traction Electrique à 2400 Volts). An account of the St. Georges de Commières à la Mure line near Grenoble, France, taking its current from the hydro-electric station in the Alps; with details of the route and the locomotives. 2500 w. Génie Civil—June 2, 1906. No. 78119 D.

Turbine Plant.

New Turbine Plant for Railway Lighting and Power Service. Illustrated description of a new system, employing alternating-current transmission at high voltage, recently installed at Portsmouth, Ohio. 2000 w. Engr, U S A—July 16, 1906. No. 77993 C.

Underground.

The Paris Metropolitan Railway; the Place de l'Opéra. An illustrated account of the special difficulties encountered in the construction at this point. 1100 w. Engng—July 6, 1906. No. 77986 A.

We supply copies of these articles. See page 995.

EXPLANATORY NOTE—THE ENGINEERING INDEX.

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B, or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H. of $1.60. When the letter N is used it indicates that copies are not readily attainable, and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

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THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

American Architect. *w.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. Ing. e d Arch. Ital. *w.* Rome.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *m.* New York.
Automobile Magazine. *m.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bull. Am. Iron and Steel Asso. *w.* Phila., U. S. A.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. Soc. Int. d'Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bulletin Univ. of Kansas. *b-m.* Lawrence.
Bull. Int. Railway Congress. *m.* Brussels.
California Jour. of Tech. *m.* Berkeley, Cal.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *m.* Toronto and Montreal.
Canadian Mining Review. *m.* Montreal.
Cassier's Magazine. *m.* New York and London.
Cement. *b-m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l'Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Deutsche Bauzeitung. *b-w.* Berlin.

The New Public Service Building of the Milwaukee Electric Railway and Light Company. Illustrated detailed description of a building which combines a terminal station for interurban service, and an office building devoted to the needs of the company. 6000 w. St Ry Jour—July 14, 1906. No. 77932 C.

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The Commerce Street Power Plant of the Milwaukee Electric Railway & Light Company. Illustrated description of the changes which have more than doubled the capacity of the plant. 2800 w. Elec Ry Rev—July, 1906. No. 77965.

Rail Joints.

Rail Joints for Electric Street Railways (Die Stossverbindung der Rillenschienen Elektrischer Strassenbahnen). Max Buchwald. Illustrations of various forms of German rail joints, and of a portable milling machine for finishing the surfaces. 3000 w. Elektrotech Zeitschr—June 28, 1906. No. 78165 B.

Rapid Transit.

Rapid Transit in Chicago. A report submitted by Bion J. Arnold to the Committee on Local Transportation of the Chicago City Council, July 2, 1906. Recommendations as to what to do at present. Map. 2800 w. R R Gaz—July 13, 1906. No. 77951.

The 60,000-Volt Sub-Station and Transmission Line of the Syracuse Rapid Transit Company. An account of the transmitting of a 60,000-volt current generated at Niagara Falls, 165 miles to Syracuse, to be utilized for operating the traction system of the city. 4500 w. St Ry Jour—July 14, 1906. No. 77933 C.

Shops.

The New Car House and Remodeled Shops of the International Railway Company, Buffalo, N. Y. Illustrates and describes recent improvements in the carhouse and shop facilities at the Cold Springs depot. 4500 w. St Ry Jour—July 7, 1906. No. 77847 C.

Signalling.

Some Recent Block Signal Systems for Electric Railways. Gives particulars of some systems which have been put in service, with diagrams. 3500 w. Eng News—July 19, 1906. No. 78070.

Single Phase.

The Finzi Single-Phase Railway System (La Ferrovia Monofase Sistema Finzi). A brief description, with sheet of illustrations of the Finzi system of monophase electric traction, as exhibited at Milan. 1200 w. 1 plate. L'Industria—April 29, 1906. No. 78177 D.

Snow.

Methods of Handling Snow on Electric Railways. Gives particulars as to methods and equipments employed by a number of interurban railways in different parts of the United States. Ills. 4500 w. Eng News—July 26, 1906. No. 78234.

Station.

Commonwealth Electric Company's New Station. An illustrated detailed description of the first steam turbine generating station in Chicago. 4000 w. Ir Age—July 20, 1906. No. 78226.

Park Royal Power Station and the Hammersmith and City Electric Railway. Detailed description of the new generating station of the Great Western Ry. Co., and the lines which it serves. 3500 w. Elec Rev, Lond—June 22, 1906. Serial. 1st part. No. 77778 A.

Subways.

Station Locations in the Washington Street Tunnel, Boston. Map, plans, and description of the Washington Street tunnel and platforms. 1000 w. Ry Age—July 27, 1906. No. 78289.

Test Commission.

Electric Railway Test Commission. Henry V. Norris and Bernard V. Swanson. An analysis of the work by this commission, discussing its organization, the investigations and deductions. 2800 w. Elec Ry Rev—July, 1906. No. 77964.

Traction.

Electric Traction at 2400 Volts (Traction Electrique à 2400 Volts). An account of the St. Georges de Commières à la Mure line near Grenoble, France, taking its current from the hydro-electric station in the Alps; with details of the route and the locomotives. 2500 w. Génie Civil—June 2, 1906. No. 78119 D.

Turbine Plant.

New Turbine Plant for Railway Lighting and Power Service. Illustrated description of a new system, employing alternating-current transmission at high voltage, recently installed at Portsmouth, Ohio. 2000 w. Engr, U S A—July 16, 1906. No. 77993 C.

Underground.

The Paris Metropolitan Railway; the Place de l'Opéra. An illustrated account of the special difficulties encountered in the construction at this point. 1100 w. Engng—July 6, 1906. No. 77986 A.

We supply copies of these articles. See page 995.

EXPLANATORY NOTE—THE ENGINEERING INDEX.

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B, or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H. of $1.60. When the letter N is used it indicates that copies are not readily attainable, and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

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THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

American Architect. *w.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. Ing. e d Arch. Ital. *w.* Rome.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *m.* New York.
Automobile Magazine. *m.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bull. Am. Iron and Steel Asso. *w.* Phila., U. S. A.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. Soc. Int. d'Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bulletin Univ. of Kansas. *b-m.* Lawrence.
Bull. Int. Railway Congress. *m.* Brussels.
California Jour. of Tech. *m.* Berkeley, Cal.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *m.* Toronto and Montreal.
Canadian Mining Review. *m.* Montreal.
Cassier's Magazine. *m.* New York and London.
Cement. *b-m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l'Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Deutsche Bauzeitung. *b-w.* Berlin.

Domestic Engineering. *m.* Chicago.
Economic Geology. *m.* So. Bethlehem, Pa.
Eisenbahntechnische Zeitschrift. *b-m.* Berlin.
Electrical Engineer. *w.* London.
Electrical Magazine. *m.* London.
Electrical Review. *m.* London.
Electrical Review. *w.* New York.
Electric Journal. *m.* Pittsburg, Pa.
Electrical World. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Electricity. *w.* London.
Electrochemical and Met. Industry. *m.* N. Y.
Elektrotechnische Zeitschrift. *w.* Berlin.
Elektrotechnik u Maschinenbau. *w.* Vienna.
Electrotechnische Zeitschrift. *w.* Berlin .
Elettricità. *w.* Milan.
Engineer. *w.* London.
Engineer. *s-m.* Chicago.
Engineering. *w.* London.
Engineering and Mining Journal. *w.* New York.
Engineering Magazine. *m.* New York and London.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Engineering Review. *m.* London.
Eng. Soc. of Western Penna. *m.* Pittsburg, U.S.A.
Far Eastern Review. *m.* Manila, P. I.
Fire and Water. *w.* New York.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giorn. dei Lav. Pubb. e d Str. Ferr. *w.* Rome.
Glaser's Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Ice and Refrigeration. *m.* New York.
Industrial World. *w.* Pittsburg.
Ingenieria. *b-m.* Buenos Ayres.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Int. Marine Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron and Steel Trades Journal. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. Am. Foundrymen's Assoc. *m.* New York.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal of Electricity. *m.* San Francisco.
Journal Franklin Institute. *m.* Philadelphia.
Journal of Gas Lighting. *w.* London.
Journal Royal Inst. of Brit. Arch. *s qr.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. o fEngineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Journal of U. S. Artillery. *b-m.* Fort Monroe, U. S. A.
Jour. W. of Scot. Iron & Steel Inst. *m.* Glasgow.
Journal Western Soc. of Eng. *b-m.* Chicago.
Journal of Worcester Poly. Inst., Worcester, U. S. A.
Locomotive. *m.* Hartford, U. S. A.
Machinery. *m.* New York.
Madrid Cientifico. *t-m.* Madrid.
Marine Review. *w.* Cleveland, U. S. A.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Métallurgie. *w.* Paris.
Minero Mexicano. *w.* City of Mexico.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining Reporter. *w.* Denver, U. S. A.
Mittheilungen des Vereines für die Förderung des Local und Strassenbahnwesens. *m.* Vienna.
Motor Wagon. *w.* Cleveland, U. S. A.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *m.* New York.
Nature. *w.* London.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Oest. Wochenschr. f. d. Oeff. Baudienst. *w.* Vienna
Oest. Zeitschr. Berg & Hüttenwesen. *w.* Vienna.
Plumber and Decorator. *m.* London .
Popular Science Monthly. *m.* New York.
Power. *m.* New York.
Practical Engineer. *w.* London.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. Pac. Coast Rwy. Club. *m.* San Francisco.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Pro. U. S. Naval Inst. *qr.* Annapolis, Md.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railroad Gazette. *w.* New York.
Railway Age . *w.* Chicago.
Railway & Engineering Review. *w.* Chicago.
Railway and Loc. Engng. *m.* New York.
Revista d Obras. Pub. *w.* Madrid.
Review of Reviews. *m.* London & New York.
Revista Tech. Ind. *m.* Barcelona.
Revue de Mécanique. *m.* Paris.
Revue Gén. des Chemins de Far. *m.* Paris.
Revue Gén .des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Revue Technique. *b-m.* Paris.
Rivista Gen. d Ferrovie. *w.* Florence.
Rivista Marittima. *m.* Rome.
Schiffbau. *s-m.* Berlin.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Engng. *m.* Ithaca, N. Y.
Stahl und Eisen. *s-m.* Düsseldorf.
Stevens Institute Indicator. *qr.* Hoboken, U. S. A.
Street Railway Journal. *w.* New York.
Street Railway Review. *m.* Chicago.
Technograph. *yr.* Urbana, Ill.
Technology Quarterly. *qr.* Boston, U. S. A.
Tijds v h Kljk. Inst. v Ing. *qr.* Hague.
Tramway & Railway World. *m.* London.
Trans. Am. Ins. Electrical Eng. *m.* New York.
Trans. Am Ins. of Mining Eng. New York.
Trans. Am. Soc. Mech. Engineers. New York.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Transport. *w.* London.
Wood Craft. *m.* Cleveland, U. S. A.
Yacht. *w.* Paris.
Zeitschr. d. Mitteleurop. Motorwagon Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver Deutscher Ing. *w.* Berlin.
Zeitschrift für Elektrochemie. *w.* Halle a S.

IMPROVED MACHINERY

New Processes and Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

Shops of the Western Electric Company.

THE Hawthorne shops of the Western Electric Company consist of six principal groups of buildings. In addition to the office, foundry, forge shops, machine shops, cable and rubber plants, there are a gas plant, water-tower, power plant and two crematory buildings. The entire plant covers approximately 1,000,000 square feet of floor space and is located on a tract of land of 110 acres. The Chicago Terminal and Manufacturers' Junction Railway tracks pass through the property and connection is made by an elevated spur track to the main line of the C. B. & Q. Railway.

The foundry is a brick and steel structure, 400x176 feet, and 75 feet at its highest point. It is divided into three bays. Over the main bay are two 30-ton cranes. The west bay is 75 feet wide and is used exclusively for bench work, while the east bay, 30 feet wide, is divided into sections containing the cupolas, storage bins and core ovens. The machine shop is 860x150 feet, of the same type of construction as the foundry. There are three bays. The center one, 76 feet wide, is devoted to the manufacture of generators and motors; the north bay, 48 feet wide, contains such machine tools as are required in the manufacture of small types of machines. In this bay is located the testing department. The south bay has two floors, the upper one being devoted to the manufacture of small field coils and the winding of small armatures, as well as the small detail and finishing departments. The lower floor contains the commutator and large detail departments, stock rooms and general shop offices, including that of the shipping department. Over the main bay are two 30-ton, and over the north bay six 20-ton cranes. The entire plant is equipped with a system of industrial railways.

The boiler room has an area of 20,700 square feet and is designed for two chimneys, each 12 feet inside, and 22 feet outside diameter, and 250 feet in height above the boiler-room floor. One of these chimneys has been built and the other is in process of construction. Provision has been made for two batteries of boilers of eight each, a chimney dividing each battery into two sets of four. At present there has been installed eight boilers, each with a heating surface of 5,030 square feet and operating at 150 pounds. Contracts have

been made for increasing the boiler capacity 25%. The present boilers are so arranged that superheaters may be installed at a later date, should it be thought advisable.

Chain grate stokers are used, having a grate area of 77 square feet. Each set of four boilers is provided with a fuel economizer of 68 sections, 12 tubes wide. The water-tubes of the boilers are cleaned by means of a hydraulic driven cleaner supplied with water from a 7½x5x6 pump.

The railroad tracks are of such a height that cars may be switched by means of an elevated spur track into the storage bins located above the boiler room. These bins are of 1,000 tons capacity and are so designed that the coal may be discharged through spouts into a hopper scale for each division of boilers. This scale is mounted on a track, so as to take the coal from any part of the bin and deliver it to any one of the stokers. The ash is discharged at the end of a chain grate stoker into a bin of 1½ tons capacity located below each boiler. From these bins the ash may be delivered into gondola cars and taken by means of a depressed railroad track to various places about the plant where filling may be required.

The engine room and condenser pit have a total floor space of nearly 16,000 square feet and contain a power plant of a capacity for continuous service of 3,000 K. W. and for two hour service of 4,500 K. W. There are four units, one each of 300, 500, 1,000 and 1,200 K. W. capacities. The larger generator is driven by a vertical cross-compound engine. The diameters of the cylinders are 32 inches and 62 inches, the stroke 48 inches, and the piston speed 800 feet per minute; the R. P. M. being 100. The 300 and 500 K. W. generators are driven by a horizontal cross-compound engine, and the 1,000 K. W. by a vertical cross-compound.

Three surface condensers are located in the condenser pit, two of 3,200 square feet and one of 4,500 square feet cooling surface; also three duplex single-acting air pumps, 7½ inches x 16 inches x10 units for the smaller condenser and 9 inches x 20 inches x 12 units for the larger condenser.

The accompanying illustrations show an interior view of the machine shop and the exterior of the foundry.

Cyclopean Dumping Buckets.

THE accompanying illustration shows one form of dumping bucket made by the Cyclopean Company, successors to the Cyclopean Iron Works of New York, and made under the Harold patents. The buckets specially designed for handling concrete are made funnel-shaped, so that when the bottom is released the entire load is dumped in a concentrated mass, right where directed. There is no shock to the concrete already placed, because the buckets can be lowered down onto the work, in the trenches or braced excavations, or forms. There is no side swing or back kick to break the tie-rods, knock-out bracings, or get the forms out of alignment,—thereby saving much valuable time, extra expense and avoiding annoyance. There is no danger

of breaking the bond formed during the initial set of the concrete already placed. There is no splashing or rattling of the concrete, as when using the type of buckets that tip over, dumping from the top. The entire contents are deposited in a concentrated mass, in a moment. These buckets are always in the right position and can be dumped anywhere without special effort. There is no pounding or digging to get all the material out. No further attention is needed, the buckets closing themselves when lowered to the ground.

Buckets designed for handling excavation, mud, clay, rock, etc., differ only in shape from the buckets for handling concrete. They are made practically vertical in the sides, slightly larger at the bottom, thereby making it impossible for any kind of material to stick or arch in them. The Cyclopean Company, 30-32-34 Franklin street, Brooklyn, N. Y., will send full details on request.

Lane Automatic Lock Tackle Blocks.

THE use of tackle blocks is generally so well understood that any comment upon it among practical and scientific men might be almost considered superfluous, but the automatic lock block shown in the accompanying illustration which is manufactured by Lane Brothers Co., Poughkeepsie, N. Y., really brings blocks into a new field of usefulness in the shop and in connection with a great deal of general engineering and construction work on account of the usefulness of the locking appendage. In machine shops, for instance, chain blocks are commonly used for raising and handling work too heavy to be conveniently moved by hand. Practically all chain blocks possess this self-sustaining feature, which is particularly useful in the shop, whether adjusting work on machine tools or carrying a load along an overhead trackway, but in many instances, perhaps in the majority of cases, the load handled is comparatively light, that is, easily and more properly within the limits of an ordinary block and fall, but the more cumbrous chain hoist is resorted to on account of this self-sustaining feature.

In the case of the Lane blocks it is pointed out that they are as convenient in every way as the ordinary form of tackle block, the blocks themselves being comparatively light and easy to handle, while the load, of course, can be raised and lowered quickly and locked in any position simply by slacking on the hauling rope while it is being held back at a slight angle from the fall. This, as will be seen from the illustration, carries a guard ring which encircles the hauling rope back slightly and the lock lever swinging on the pivot shown at the rear edge of the case throws the grip piece down upon the rope over

the pulley. This lock piece is corrugated on the under side to fit the strands of the rope, and as the strain is released on the hauling rope the lock moves down with the rope over the pulley, but constantly approaching the latter till at the nearest point the levers strike the hub of the sheave. It is only in very extreme cases however that the lock will go so far down. Ordinarily it stops in about the position

shown in the illustration due to the pressure on the rope. It will be noted that the strain of the load as held by the lock tends to pull the latter down and grip it tighter upon the rope; that is, the lock is really held in position with a force practically equal to the pull on the rope that it is holding, and consequently no accidental jar or flapping of the hauling rope in the guard ring would have any effect to release it. It can only be released by actually moving both rope and lock together upward for a slight distance till the grip piece swinging on the center from the pivot at the back edge of the case moves far enough away from the rope to clear it. As soon as the lock is disengaged from the rope its position of course is controlled by the guard ring at the opposite end of the lever; that is, by the angle of the hauling rope. It is also a fact that when used in the vertical position the lock will be brought into action by gravity if the strain on the hauling rope is absolutely released, as for instance if the rope breaks or is cut. It is evident that this locking device is equally operative if the blocks are used in a horizontal position for hauling, except that in such case the lock will not act by gravity, but is controlled entirely by the angle of the hauling rope. At first thought the use of the automatic lock for horizontal hauling might be lightly considered, but as a matter of fact it is often very important particularly with a long fall, as it holds all that is gained in pulling and prevents the elasticity of the rope pulling it back again each time the strain is relieved. In the same way it is also possible for one man to lift very materially more with these blocks when used in a vertical position than with equivalent blocks without the lock, for the lock will hold all that he can gain in the extreme effort, which anyone will recognize is materially more than can be maintained in a steady pull.

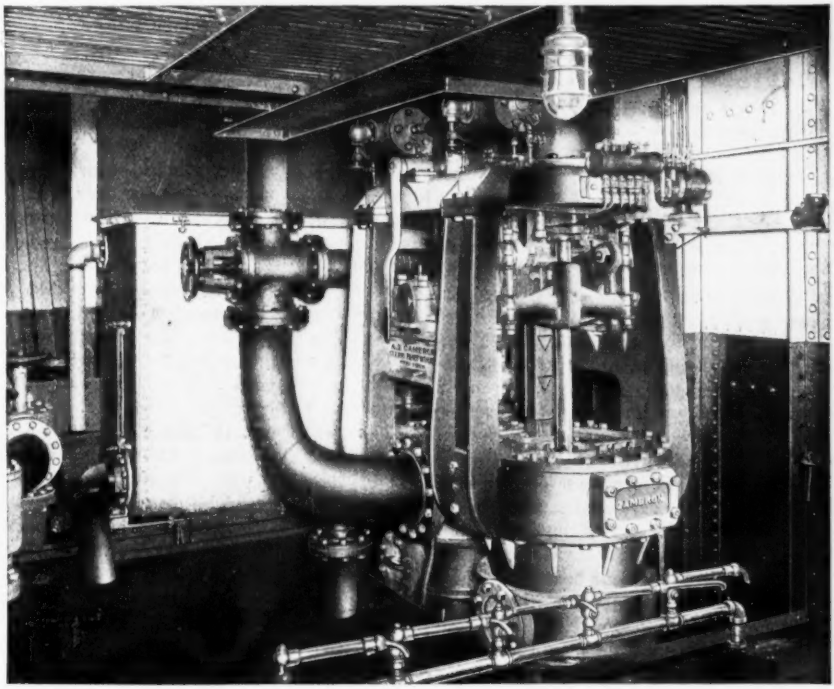
A very similar block is also manufactured by this company in which the lock is operated entirely by gravity and lifted by a check cord. This latter block is used in some special cases where the angle of the hauling rope cannot be changed, as in hauling by power over a guide pulley.

They also have a cheaper grade of block in which the rope is held by wedging it in a "V" shaped aperture, which has come largely into use for wire stretching and similar work.

Condenser Pumps on Municipal Ferry-Boats.

THE maximum efficiency of a condensing apparatus can only be obtained by observing certain laws and conditions which affect them. The injection or cooling water must be provided in a certain determinate quantity, depending upon the temperature of the water and amount of steam to be condensed. If the injection water is liable to be quite warm at times, the air pump and condenser must be proportioned to suit the condition of highest temperature of the water. If, for example, the water obtainable is liable to reach 80 degrees, the quantity of injection water relative to the steam to be condensed will be as 55 to 1, assuming the temperature of discharge from air pump to be 100 degrees, while if the water is 60 degrees only, one-half that quantity will do the work.

The size of condenser or condenser volume is not an important factor, as when an ultimate association of steam and injection water is accomplished, that is the only thing to be considered. But in the jet condenser system the size of the air pump is of the utmost importance. With the ordinary horizontal direct-acting machine the piston speed should not exceed about 70 feet per minute, and the pump should be so proportioned that the speed will be less rather than greater. As the amount of air which will enter the condenser is an uncertain quantity in actual service, the exact size of the air pump cannot be positively determined, but it should be amply large to provide for the contingencies likely to arise due to leakage and imperfection, which permit of the admission of an undue amount of air from the atmosphere.



From the above it will be apparent that the size of condensing apparatus cannot be determined from the engine horse-power, unless the number of pounds of steam per horse-power the engine uses is known. In other words, the size can only be determined from a knowledge of the steam of

a certain pressure to be condensed. And no matter how the problem is presented, no accurate calculations can be made unless sufficient data is given to permit of its resolution into the weight of steam and its temperature. The temperature, however, is generally assumed, as under ordinary conditions the temperature of exhaust is very nearly the same.

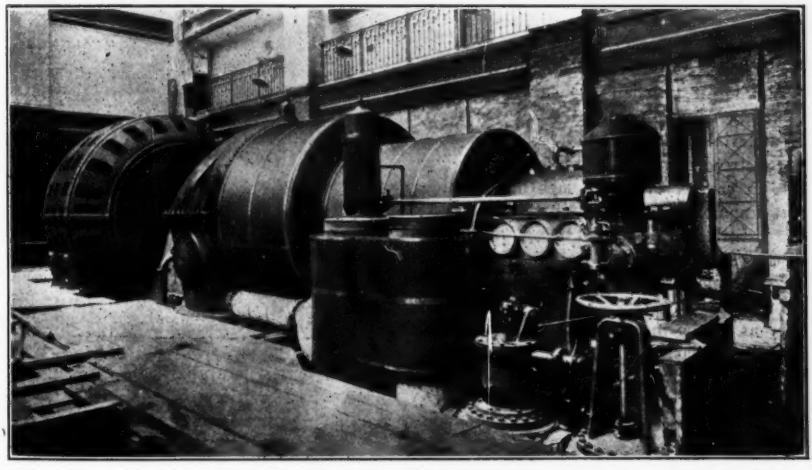
We are indebted to J. J. Herrick, mechanical engineer of the New York Dock Department, for information pertaining to the relative size of engines and condensing system in use on each of the five new municipal ferryboats, which are now running between Manhattan and Staten Island. They are propelled by twin screws, driven by two inverted, direct-acting, two-cylinder compound engines, having crank shafts bolted together, and with steam cylinders 22½ inches and 50 inches diameter by 30 inches stroke, and develop over 4,100 H. P. at 157 R. P. M., but in regular service only 3,000 H. P. is developed. The main surface condenser which takes care of the exhaust steam of these engines and auxiliaries, contains 1,884 tubes ¾ inch outside diameter by 12 feet 4¾ inches long, having a condensing surface of 4,513 square feet. The vacuum gauges show ordinarily 26 inches, but sometimes 27 inches. The centrifugal circulating pump has 12 inches suction and discharge, and is driven by a 9 inch x 9 inch vertical engine, making 160 R. P. M. The approximate amount of steam condensed by the engines per hour is about 18 1-3 lbs. per horse power; thus, as 3,000 H. P. is developed, making steam consumption about 55,000 lbs. per hour. The Cameron vertical twin beam air pumps installed on these boats, as shown in the accompanying photographic reproduction, are used to pump the condensed exhausted steam from the main condensers, and deliver it to the feed water tank or overboard; being of ample size, with 10 inch steam cylinders and 22 inch air cylinders, with 18 inch stroke. The steam end consists of two independent Cameron vertical steam cylinders, designed to withstand the high steam pressure and temperature common to marine work, and having their steam chest plungers connected together, thus insuring absolute certainty of harmonious action under all conditions. At the same time, should it be desired for any reason to run either steam cylinder alone, the other may be disconnected in a very few minutes and the whole pump driven by one steam cylinder. Every detail has been worked out with great care and exactitude and this equipment has been found very satisfactory and economical.

Starting Up of a Steam Turbine.

A LARGE steam turbo-alternator built by the Allis-Chalmers Company has been started up with great success under such circumstances as to deserve chronicling. The turbine referred to is one of 5,500 K. W. rated capacity, installed in the Kent avenue power house of the Brooklyn Rapid Transit Co. The turbine and its direct-connected alternator were ready for operation on February first, but the boilers, condensing apparatus, piping, etc., were not completed until late in March. While lying idle for nearly two months in an uncompleted station, the insulation of the generator windings naturally became damp, and therefore, as soon as steam was available for running the turbine, it was started up at part speed to dry out the generator. This drying-out process was going on when a mishap at another power house left the railway company short of power. The urgency of the situation was explained to the Allis-Chalmers representatives at about ten o'clock and they were asked whether they could help out with the afternoon load. Feeling a strong confidence in their apparatus, the engineers decided to put the turbine into regular operation, notwithstanding the fact that it had never been under load, nor had it even been up to speed except when running unloaded at the West Allis shops. Additional boilers were therefore fired up and other preparations made for starting. The turbine continued to run slowly until twelve o'clock to dry out the generator. It was then shut down and the engineers proceeded with progressive tests of the insulation, testing up to such a point as they considered safe for the rated voltage of 6,600, but not considering it wise to risk too high a test in view of the damp state of the generator. The insulation tests were completed at 1.56 P. M. and the turbine was again started

up, and ran up to the full speed of 750 R.P.M. for the first time since installation at the power house. At 2.20 P. M. the engineers, after carefully assuring themselves that everything was working well, reported that they were ready, and an increasing load was immediately put on until at 3.05 the turbine was carrying a little over 3,000 K.W. which was all that the railway company needed at that time.

It is believed that such a performance has never been equalled in the history of steam-electric engineering—to carry successfully, in regular operation, a load of 5,000 horse power within three quarters of an hour after the machine had been put up to full speed for the first time. As more load was called for, it was put on, and at 3.45 P. M. the unit was carrying over 4,000 K.W. On the following day the load ran up to over 5,000 K.W., and on the succeeding it reached 7000 K. W.,



the turbine taking heavy loads during the morning and afternoon peaks, and running until late each night.

By this time the other apparatus of the transit company being again in working order, an opportunity was given to lay off the turbine and open it up for exaamination. Heretofore, in the operation of steam turbines, in numerous cases the turbine cylinders have slightly arched upwards under the effect of superheated steam, on account of the top of the cylinde expanding more than the bottom, and in a considerable number of instances this has caused the rotating blades to come in contact with the cylinder and be ripped out. In the Allis-Chalmers design it was sought to overcome the distortion of the cylinder by such a distribution of the metal as to cause nearly equal expansion of the top and bottom of the cylinder, but at the same time the turbine drum was placed slightly above the center of the cylinder to assist in preventing contact of the blades in case of distortion. When the turbine had opened up, however, it was found that the compensation for distortion had been slightly overdone, and the cylinder had sagged a small amount and this, together with the high position of the drum, had caused the blading to rub hard for nearly a third of the length of the turbine. With the older types of construction such contact would immediately have made itself manifest by the noise of the rubbing blades, and the blades would have been ripped out before the turbine could be stopped. In this turbine, however, there had, while in operation, been no indication of the blades rubbing and no damage whatever had been caused; the only sign of contact having taken place was a slight wearing away of the flanges of the channel shaped shroud ring which protects the tips of the blades in the Allis-Chalmers construction. Besides the blades

which rubbed on account of the slight distortion of the cylinder, a few rows of blades at the inlet end of the turbine were found to have rubbed on sand and other dirt which had gotten into the turbine from the steam pipes, but in this case also the shroud ring prevented all damage.

The only precaution taken before starting up again to help carry the Coney Island load on the following Sunday was to lower the drum a few thousandths of an inch at each end. So far as known this has prevented all further rubbing, and the turbine has been in daily operation ever since, and has not again been opened.

Eldred Process of Cement Burning.

FOLLOWING the lead of the Lawrence Cement Company at Siegfried, Pa., in the use of the Eldred process for cement burning, numerous other plants report splendid results in increased output and saving of fuel. The new process brings into play the important principle of impoverishing the air blast as to oxygen by dilution with waste stack gasses, thereby making it possible to use a tempered impinging flame and directing the heat on the material where it is most needed without destroying the kiln linings. The air blast in cement burning plays one of the most important parts of its manufacture, though little has been said about this phase of the subject. The blast employed at present comes either from compressed air or from a rotary fan. The manufacturers differ as to the merits of the two. However, either blast must be of sufficient force to blow the powdered fuel into the kiln. In connection with this blast the fuel is passed into a nozzle in the center of which is a pipe connected with the fan or compressor. The air forces the small particles of coal through the pipe and into the kiln where it is ignited, creating an intense flame by rapid combustion. Until recently it was found impracticable to direct this flame other than axially into the kiln, thereby burning the material by a radiated flame instead of the more effective impinging flame.

Cement manufacturers realized long ago that the hottest part of the flame was at its center, and so directed it on the material. They soon found, however, that although it burned the material much faster than where placed axially, it also burned the kiln lining. In consequence they had to abandon the impinging flame in its then form and go back to the axial flame. The Eldred Process Company were the pioneers in burning cement exclusively with an impinging flame. To accomplish this long sought for result a medium different from fresh air is employed, this medium making possible the use of the impinging flame practically consisting of carbon dioxide. By the method employed, products of combustion taken from the stack are mixed with a proper proportion of fresh air. This mixture is then drawn in either by induction, where compressed air is used, or by an exhauster, where a fan is used. It is then forced through the fuel nozzle into the kiln. With this air gas mixture a long or short flame may be produced which may be moderated or increased in intensity at the will of the operator.

It is well known that where rapid combustion takes place, such as with pure air and powdered fuel, the material back of this intensely heated flame in a long rotary kiln must depend upon the heat of this combustion to drive off the carbon dioxide contained in the material. It is also a fact that this heat diminishes with great rapidity, having nothing to sustain its temperature. On the other hand, if this first combustion was somewhat prolongated as it is with carbon dioxide, it would naturally create a longer flame. Moreover, a flame composed of a mass of intensely heated combustible gas naturally has a greater calcining effect on the material in the kiln, thus driving off a larger proportion of carbon dioxide from the material and rendering it easier for clinkering.

It is evident from these facts that with the use of the products of combustion properly proportioned in the air blast a greater output of material is possible, as well as a marked saving in fuel consumption. Since the energy in the coal is distributed over a large area the formation of "rings,"—one of the most objectionable features with which cement manufacturers have to contend—is eliminated by the Eldred process.

NEWS SUPPLEMENT

The Engineering Magazine—June, 1906

Personal.

—J. W. Duntley, president of the Chicago Pneumatic Tool Co., has sailed for Europe in the interest of the company's business.

—Robert McF. Doble, consulting and supervising engineer, announces the removal of his office from San Francisco to Colorado Springs, Colo.

—F. L. Martin has resigned his position as advertising manager of Stromberg-Carlson Telephone Manufacturing Co., and is now associated with White's Class Advertising Co., Chicago.

—Announcement is made of the appointment, effective September 1st, of Dr. W. K. Hatt as Professor of Civil Engineering at Purdue University, succeeding Professor W. D. Pence, resigned.

—Heinrich J. Freyn has resigned his position as engineer of the gas engine department of the Wellman-Seaver-Morgan Co., and has accepted a position with the Illinois Steel Co., So. Chicago, Ill.

Industrial Notes.

—Star Brass Manufacturing Co. announce the removal of their New York office to 70 Cortlandt Street.

—The Risdon Iron Works, with offices at 298 Stewart Street, San Francisco, announce that their works were uninjured after the earthquake, and are in full operation.

—The New York Telephone Co. has issued a pamphlet treating of telephone competitions in various American cities, giving the rates and number of users of the Bell and independent companies.

The Atlas Portland Cement Co., Northampton, Pa., recently purchased two 50 horse-power Allis-Chalmers type "H" motors for the operation of cement machinery. They will be built at the company's electrical works, Cincinnati.

—Fairbanks, Morse & Co., San Francisco, will occupy temporary headquarters at 969 Broadway, Oakland, until they are able to return to their permanent location in San Francisco, where they were recently burnt out in the conflagration following the recent earthquake.

—Sullivan Machinery Co., Chicago, announce that their temporary San Francisco office is located at 1010 Washington Street, Oakland, Cal., where they will carry a stock of rock drills and their parts and air compressors. H. I. Walsh is the Pacific Coast manager.

—An order has been placed with the Crocker-Wheeler Co., Ampere, N. J., for an engine type generator of 100 kilowatts capacity, to be used as exciter for large turbo generator recently installed. This outfit is to be installed at the Philadelphia Rapid Transit Co.'s Power Station, Philadelphia.

—A novel arrangement is in use by the Philadelphia Rapid Transit Co., Philadelphia, Pa., for the local welding of track joints. This consists of a small foundry cupola carried on a trolley car and supplied with blast from an electric pressure blower, furnished by the B. F. Sturtevant Co., Boston.

—The Electric Welding Manufacturing Co., Pittsburg, have recently added several more large electric welding machines, and are now equipped to handle commercial electric welding work on a large scale. At present the works are running to capacity manufacturing reinforcement for the Cummings system of reinforced concrete.

—John B. Eyres, Paterson, N. J., is installing a refrigerating machine, also one 7 horse-power and one 13 horse-power Hornsby-Akroyd oil engine. The 13 horse-power oil engine is to drive the refrigerating machine. Both the refrigerating machine and oil engines are supplied by the De La Vergne Machine Co., New York.

—Locke Regulator Co., Salem, report that they have received an order from the Interstate Railways Co., Philadelphia, to equip the first of their engines with the Locke engine stop. They are also about to equip six mills for the American Thread Co., New York. The Locke stop is an independent engine stop system and has been

accepted by the United States Government Engineers.

—Harron, Rickard & McCone state that through the recent catastrophe in San Francisco they were seriously damaged. As nearly as they can learn a large portion of the machinery on the second floor was unharmed, but their offices and such machinery as they had on the ground floor was completely destroyed. Their warehouse was not reached by the fire. They have opened a temporary office at 7th and Berry Streets, San Francisco.

—During the recent fire in San Francisco the catalogue files of many of the companies were completely destroyed. The following San Francisco concerns announce that they would be pleased to receive catalogues, price lists, etc., from manufacturers of machine tools, power plant equipment, electrical and hydraulic machinery and structural materials: Abner Doble Co., 2611 Broadway, Main Street Iron Works, 1024 Francisco Street, and Ohmen Engine Works, 15th and Utah Streets.

—The McGraw Publishing Co., publishers of the Engineering Record, Street Railway Journal, Electrical World, and other periodicals, have just placed a contract with Frank B. Gilbreth, New York, for the erection of a new building to be erected at 39th Street between Seventh and Eighth Avenues. The plot is 126.4 feet long and 98.9 feet deep. It is planned to make this structure ten stories high with the lower four floors devoted to printing machinery, the top floor to an engraving establishment and the remaining floors to offices. It is proposed to construct this building entirely of reinforced concrete.

—Notwithstanding the complete destruction of its San Francisco works in the great fire, the Pelton Water Wheel Co. was particularly fortunate. All drawings, books and cost records were saved, together with several years' correspondence. In addition, this company has had under construction for several months past new works in San Francisco. These were outside of the fire zone, and are being rushed to completion, so that they will be running as usual within a couple of months. In the meanwhile, the shops of the company at New York will be utilized for the fulfillment of current orders, so the business will continue practically without interruption. Temporary offices have been established at 1259 Alice Street, Oakland, Cal, to which communications should be addressed. The Atlantic Department is as formerly, 143 Liberty Street, New York.

—The controlling interest in the Engineering Agency, Incorporated, Chicago, which was organized in 1893 by Frederick A. Peckham, has been purchased by A. G. Frost. At the last directors' meeting Mr. Frost was elected president. R. D. Smith, vice-president, and P. W. Herring, secretary and treasurer, retain their office as heretofore. The Agency has a branch office in Pittsburg and contemplates opening within the next thirty or sixty days offices in New York and Denver. The head of the mining department of one of the prominent western mining schools will probably take hold of the company's western business. Through the J. G. White Company the Agency has sent a party of twenty men to the Philippines on the Government railroad work there. Men are constantly being sent to Mexico, South America and the far west.

—The Abner Doble Co., engineers and water wheel manufacturers of San Francisco announce that their works and offices at Fremont and Howard Streets were entirely destroyed by the fire. Temporary offices have been opened up at the residence of President W. A. Doble, 2611 Broadway, San Francisco, where the business of the company will be conducted for some little time. Immediately after the fire, steps were taken to erect the permanent shops of the company on the block bounded by Seventh, Hubbell, South and Sixteenth Streets, where the company had planned previous to the fire to erect large shops and warehouses. Work on the new shops has already been started, and the company is rapidly getting into shape to carry to completion the large contracts which it has on hand. Prominent among these orders is that with the Government of Kashmir, British India, for the complete hydraulic installation of the Jhelum River Power Plant.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Air Compressors.

INGERSOLL-RAND CO., New York.—Catalogue illustrating and describing Imperial type X air compressors. 6 by 9 in.; pp. 32. Also a small pamphlet entitled "Compressed Air Pumping System."

GARDNER GOVERNOR CO., Quincy, Ill.—Catalogue No. 17A contains an illustrated description of air compressors. 9 by 6 in.; pp. 40, catalogue No. 16B is devoted to the Gardner governor. 9 by 6 in.; pp. 32 and catalogue No. 17 illustrates and describes duplex steam pumps. 9 by 6 in.; pp. 62. All of the catalogues are very well printed.

Belting.

MAIN BELTING CO., Philadelphia.—Booklet containing a description of Leviathan belting. Also contains many testimonial letters. 5 by 7 in.; pp. 24.

Belt Lacing.

BRISTOL CO., Waterbury.—Bulletin No. 39 is a price list of steel belt lacing. The list is given in a condensed and tabular form, enabling one to see at a glance the relation which exists between the different styles and sizes.

Boilers.

RUST BOILER CO., Pittsburg.—Catalogue illustrating and describing water tube boilers, together with views showing some recent installations. 6 by 9 in.; pp. 38.

FRANKLIN BOILER WORKS, Troy.—Catalogue containing a brief illustrated description of the Franklin water tube boilers. 10 by 7 in.; pp. 24.

SPRINGFIELD BOILER & MANUFACTURING CO., Springfield, Ill.—Catalogue illustrating boilers of all kinds, stand pipes, riveted steel pipe tanks, and all kinds of plate and sheet iron work. 6 by 9 in.; pp. 64.

Clutch Pulleys.

SPRINGFIELD GAS ENGINE CO., Springfield, O.—Pamphlet illustrating and describing friction clutch pulleys for use in connection with gas, gasoline and oil engines, together with price list. 9 by 9 in.; pp. 12. Also a catalogue treating of gas and gasoline engines. 9 by 6 in.; pp. 32.

Coal Cutters.

SULLIVAN MACHINERY CO., Chicago.—Bulletin No. 48-F illustrating and describing continuous coal cutters for undercutting coal in room and pillar mines. 6 by 9 in.; pp. 16.

Controllers.

ELECTRIC CONTROLLER & SUPPLY CO., Cleveland.—Two loose-leaf bulletins Nos. 101 and 102 illustrating and describing Dinkey ventilated and type U controllers, together with price lists. 5 by 8 in.

Conveying Machinery.

ROBINS CONVEYING BELT CO., New York.—Bulletin No. 14 devoted to conveying and elevating machinery for hauling sand, stone, cement, concrete materials and excavated earth and rock. 6 by 9 in.; pp. 24.

Corrugated Bars.

EXPANDED METAL AND CORRUGATED BAR CO., St. Louis.—Well-printed catalogue containing an illustrated description of corrugated bars for reinforced concrete, together with many views of buildings on which this bar has been used. 7 by 5 in.; pp. 232.

Electric Hoists.

WELLMAN-SEAVER-MORGAN CO., Cleveland.—Catalogue illustrating and describing electrically driven hoists, equipped with motors of various types and in a variety of styles and sizes. 6 by 9 in.; pp. 36. Also a pamphlet treating of locomotive cranes, buckets and tubs.

Electrical Equipment.

WARD LEONARD ELECTRIC CO., Bronxville, N. Y.—Catalogue illustrating and describing various appliances applications of rheostats, circuit breakers and resistance units. 9 by 11 in.; pp. 34.

Fan Motors.

GENERAL ELECTRIC CO., Schenectady.—Well-printed catalogue containing an illustrated description of fan motors. 5 by 8 in.; pp. 44. Bulletin No. 4434 treats of high candle-power incandescent lamps; No. 4436 circuit breakers and No. 4437 air brake equipment.

Gas Engines.

NEW ERA GAS ENGINE CO., Dayton.—Catalogue devoted to a general description of the New Era gas engine. Well illustrated. 9 by 6 in.; pp. 40.

S. M. JONES CO., Toledo.—Catalogue containing an illustrated description of the Acme gas and gasoline engine. 9 by 6 in.; pp. 38. Also a catalogue describing the Rathburn gas engine. 9 by 6 in.; pp. 22.

Generators.

ALLIS-CHALMERS CO., Milwaukee.—Bulletins Nos. 1050, 1412, 1700 and 1706 illustrating and describing alternating current generators—water wheel type; crushing rolls; band mills, single and double cutting; and long machinery respectively. Also a book giving instructions for setting and operating the Gates ball mill.

Grates.

MARTIN GRATE CO., Chicago.—Catalogue illustrating and describing anti-friction rocking grate for steam boilers. Contains many testimonial letters. 9 by 6 in.; pp. 28.

MCCLAVE-BROOKS CO., Scranton.—Catalogue containing an illustrated description of the McClave grates and the Argand blowers for burning cheap fuel in boilers and other furnaces. 9 by 6 in.; pp. 52.

Hoisting Engines.

LAKE SHORE ENGINE WORKS, Marquette, Mich.—Catalogue No. 5 illustrating and describing hoisting engines, rock crushers, ore cars, rope sheaves and general mining requisites. 6 by 9 in.; pp 44.

Lathes.

I. H. JOHNSON, JR., & Co., Philadelphia.—Descriptive and illustrated catalogue of lathes and other machines for working metals, etc. 12 by 9 in.; pp. 76.

Mechanical Rubber Goods.

QUAKER CITY RUBBER Co., Philadelphia.—Catalogue illustrating and describing rubber belting, hose, packings and rubber goods for mechanical purposes, together with prices. 6 by 9 in.; pp. 80.

Motors.

CROCKER-WHEELER Co., Ampere, N. J.—Bulletin No. 64 is devoted to a general description of form I motors and generators.

DIEHL MANUFACTURING Co., Elizabethport, N. J.—Bulletin No. 150 illustrating and describing types F and FC motors and generators. 6 by 9 in.; pp. 20.

Packing.

DETROIT LEATHER SPECIALTY Co., Detroit.—A well-printed and handsomely illustrated catalogue containing a brief description of leather packings for hydraulic, compressed air and all special machinery. Also contains many testimonial letters from users. 6 by 9 in.; pp. 32.

Phosphor-Bronze.

PHOSPHOR-BRONZE SMELTING Co., Philadelphia.—Price list No. 23 contains tables giving sizes, weights and prices of roll and sheet phosphor-bronze. 3½ by 6 in.; pp. 20.

Punching Machinery.

NEW DOTY MANUFACTURING Co., Janesville, Wis.—Catalogue E contains an illustrated description of punching and shearing machinery and bending and straightening rolls. 9 by 9 in.; pp. 64.

Saw Mill Machinery.

FILER & STOWELL Co., Milwaukee.—Catalogue illustrating and describing a full line of saw mill machinery. 6 by 9 in.; pp. 260.

Smelting Furnaces.

TRAYLOR ENGINEERING Co., New York.—Bulletin No. 50 illustrating and describing smelting furnaces and smelting accessories. 7 by 9½ in.; pp. 20.

Steam Engines.

B. F. STURTEVANT Co., Hyde Park, Mass.—Bulletin No. 131 illustrates and describes horizontal engines. 6½ by 9 in.; pp. 8.

A. L. IDE & SONS, Springfield, Ill.—Catalogue illustrating and describing steam engines for general power purposes. 6 by 9 in. pp. 80.

SCOTTDALE FOUNDRY & MACHINE Co., Scottdale, Pa.—Catalogue describing and illustrating Corliss engines. Also contains much valuable data. 6 by 9 in.; pp. 20.

SKINNER ENGINE Co., Erie.—Catalogue G devoted to an illustrated description of the Skinner engines with automatic system of lubrication. 9 by 7 in.; pp. 52.

MCINTOSH, SEYMOUR & Co., Auburn, N. Y.—Well-printed catalogue containing illustrations of engines of both horizontal and vertical types, together with a description of some of the constructive details and tables giving power and floor space occupied by various sizes. 12 by 9 in.; pp. 68.

Steam Pumps.

DEAN BROS. STEAM PUMP WORKS, Indianapolis.—Circular No. 54 illustrating and describing pumps. Also gives a table of sizes. 6 by 7 in.; pp. 16.

PULSOMETER STEAM PUMP Co., New York.—Small pamphlet illustrating and describing steam pumps for general low-service water raising purposes. 3½ by 7 in.; pp. 70.

GOULDS MANUFACTURING Co., Seneca Falls, N. Y.—Catalogue illustrating and describing the many different types of pumps manufactured by this company, together with tables giving capacities and power. 8 by 7 in.; pp. 192.

Steam Separators.

OHIO BLOWER Co., Cleveland.—Booklet entitled "A Model of Simplicity" presents in simple, popular language, an outline of the growth of the modern steam separator. 3 by 5 in.

Steam Specialties.

JAMES MCCREA & Co., Chicago.—Catalogue devoted to an illustrated description of steam traps, feed water regulators, etc. Pipe repairs are also treated. 7½ by 10 in.; pp. 24.

Steam Traps.

STRONG, CARLISLE & HAMMOND Co., Cleveland.—Small pamphlet devoted to an illustrated description of steam traps and other steam specialties. 6 by 3½ in.; pp. 16.

Steel.

HALCOMB STEEL Co., Syracuse.—"Hints on Steel" is the title of a well-printed booklet describing the many different grades of steel manufactured by this company. Also contains much useful information on heating, hardening, welding, etc. 4 by 6 in.; pp. 88.

Steel Trucks.

LYON METALLIC MANUFACTURING Co., Chicago.—Illustrated catalogue containing a description, together with sizes and prices, of steel trucks for factories, foundries, shops, etc. 7 by 5 in.; pp. 36.

Thermit.

GOLDSCHMIDT THERMIT Co., New York.—Pamphlet entitled "Thermit; What you can do with it," and contains a brief review of current Thermit practice. 3½ by 6 in.; pp. 12.

Turbines.

I. P. MORRIS Co., Philadelphia.—Bulletin No. 12 gives a brief description of turbines and pumps. Illustrated. 8½ by 10½ in.; pp. 10.

Water Softener.

L. M. BOOTH Co., New York.—Catalogue printed in two colors, giving a brief description of the Kennicott water softener, together with many views showing recent installations. 9 by 12 in.; pp. 54.

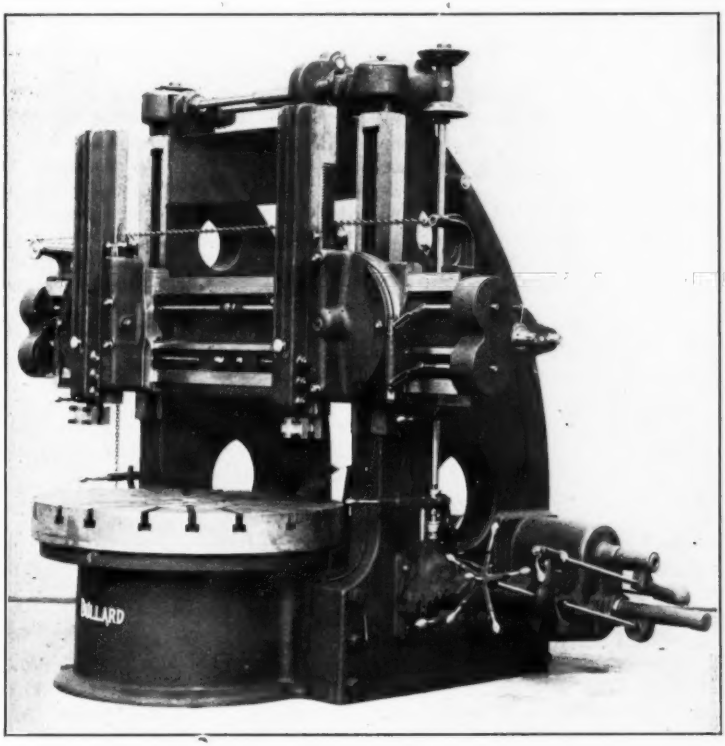
IMPROVED MACHINERY

New Processes and Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

High Speed Boring and Turning Mill.

AS illustrating the latest development in boring and turning mills, we show herewith a photograph of the Bullard 54-inch rapid production boring mill. Its actual capacity is 56 inches in diameter and 42 inches in height; the table, which is 52 inches in diameter, being driven by a large steel spur pinion meshing an internal gear at its greatest diameter. The drive is from a constant speed shaft, and fifteen changes in table speed are obtained by a speed box and a set of three reducing gears in the headstock, which is mounted on the bed between the housings. Any speed is instantly obtainable by the manipulation of a pilot wheel and lever. So completely is this idea carried out that every movement or adjustment for the entire machine, excepting the left hand head, may be consummated by the operator without taking a step.



As stated above, all speed changes are controlled by the pilot wheel and lever, as is also the quick acting brake, all move-

ments of these parts being interlocking. The pilot wheel operates the friction clutches in speed box by turning, and it applies the brake by lifting. The brake can be applied only when the frictions are disengaged, and it is rendered impossible to turn the pilot wheel while the brake is on. Similarly, the lever (behind the pilot wheel) controlling the changes in reduction gearing cannot be operated except when the brake is set, and it, in turn, locks the brake lever until a gear is fully engaged. While completely performing its function of safeguarding the driving mechanism from careless handling, this interlocking device in no way interferes with the rapid manipulation of the machine, a change from the highest to the lowest speed being made in a very few seconds. Speed changes being so readily obtained, the question of individual motor drive is materially simplified. The requirements are fully met by a constant speed motor mounted on a bracket between the housings. This bracket is so designed that if gear or chain drive is considered preferable the motor may be suspended and gears or sprockets substituted for the pulleys shown. The feeds are independent for each head, have ten changes, ranging from 1/32 to 3/4 or an inch for each revolution of the table, and are readily changed by levers. Rapid power traverse of the head and tool bar is obtained from the vertical feed rod, the cone frictions at its upper end being engaged by a horizontal lever. In its central position the feeds are engaged, but by raising or lowering the lever the clutch is released and the cone frictions brought into contact with a high speed top shaft and the rod revolved at a high rate of speed. The connection between the feed box and feed rod is a claw clutch so arranged as to engage in but one position, the rapid traverse may be used in thread cutting with no danger of a split thread resulting. The feeds are reversed in the feed box, so the position of the traverse lever bears a constant relation to the direction of movement in the head and bar, confusion in the mind of the operator being obviated.

A notable feature in connection with the feeds is the entire elimination of pull gears and crank handles at the ends of rods and screws; pull gears being replaced by gears constantly in mesh, and change from vertical to cross feed, or vice versa, being made by adjustable friction clutches operated by a lever. This device multiplies many times the value of the rapid traverse and serves the purpose of a safety slip point in an otherwise positive train of feed gears, obviating all chance of breakage and delay through careless handling.

Fine adjustment of the cutting tool is made by the double-acting ratchet levers shown attached to saddle. These ratchets automatically release their grip when the actuating pressure is relieved. This device renders it possible for the operator to set the tool to the proper depth of cut or the diameter required at close range and saves the time consumed in going to the end of the rail to make adjustments, as in the case of the ordinary machine having crank handles.

The construction of the rail is a feature which adds much to the rigidity and accuracy of the mill, as the entire weight of the head is supported by the bearing at the bottom of the rail, the upper bearing serving only to resist the tendency of the head to tilt forward under the pressure of the cut. The feed screw is directly in the center of the long, narrow, guide bearing, consequently there is no tendency to cant and bind on the rail as in the usual construction.

This principle of a guide bearing having a great proportion of length to width is also used in maintaining the alignment of the center stop on the rail, the rail being held central by a gibbed block having its bearing in the recess in the face of the right hand housing.

Another notable feature is the method of driving the top shaft which operates the rail lifting screws. The change in direction of movement is secured by tumbler gears, the driving pinion of which is cut in the end of a quill which is a running fit on the top shaft, the driving key being located in the middle of shaft in order to equalize the torsion between the ends.

Lubrication of all parts subject to wear has received special attention. Both the headstock and speed box are entirely enclosed, and the splash system of oiling is used, the gears running in a constant bath of oil. All high speed shafts have ring or chain oiling boxes and gauges are so placed as to indicate the amount of oil in each.

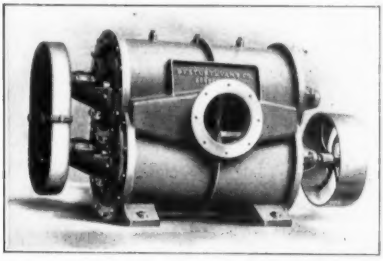
The angular thrust bearing of the main spindle is entirely immersed, oil pockets in the bed insuring ample lubrication of its entire surface, while a felt ring feeds oil to the vertical journals.

The thread cutting attachment is not a part of the regular equipment of the mill, but may be applied at any time with no further change than the substitution of extension studs for the bushings in the feed bracket on rail. Made by the Bullard Machine Tool Company, Bridgeport, Conn.

The Sturtevant High-Pressure Blower.

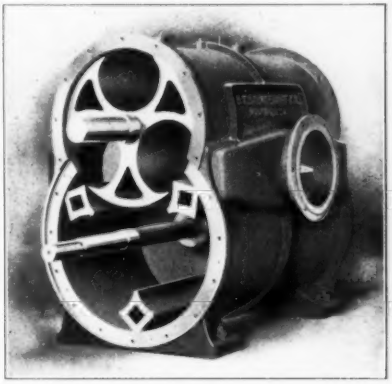
THE Sturtevant high-pressure blower is made in two types: in one, the shafts are in a horizontal plane, while in the other their axes are in a vertical plane. The blower consists of a cast-iron shell in which are two rotating members or "rotors." One of these, the impeller, is mounted on the driving shaft and revolves in the larger portion of the casing; it does the real work of compression. It is made up of three diamond-shaped bars or blades, and a central web keyed to the steel shaft. As it revolves three separate pockets are formed in the annular space between the shell and the core. Being symmetrical it is perfectly balanced at all speeds.

The other rotor, known as the idler, does no work but successively provides spaces of proper shape in order that the



impeller blades may return to the suction side of the blower without allowing the escape of any compressed air. It consists of three hollow blades or vanes cast in one piece with the shaft, which is very rigid, and, since the idler compresses no air, is of ample strength to transmit the little power necessary for rotation. The idler is turned at the same speed as the impeller by means of two spur gears running in oil and incased for protection agains dirt and accident.

Ample clearance between the rotating members insures high mechanical efficiency.



In other makes, if the clearances are very small to prevent air escaping backward to the inlet, great accuracy of finish and expensive adjustable journal boxes are necessary to render impossible the interference of the impellers. This bugbear of other types is an advantage in the Sturtevant blower; in fact, the effect of clearance is intentionally increased by the leakage passages cast in the cover plates. The small amount of compressed air that leaks backward cannot reach the inlet, for it is caught in the next pocket, increasing slightly the pressure therein and resulting in gradual compression, which contributes to a quiet-running, durable machine and a steady discharge.

Air or gas at suction pressure entering the blower is successively imprisoned in the three pockets formed by the three blades of the revolving impeller, and discharged at any desired pressure up to ten pounds per square inch. The volume of air delivered per revolution is constant; the pressure varying with the speed and resistance to passage of air.

On either side of the housing are openings for intake and discharge, flanged and drilled for standard gas-pipe fittings; the small blowers have openings at the sides and the larger sizes have openings at the top and bottom. In every respect the casing

is symmetrical, permitting the blower to run in either direction. Except in large sizes, the lower half of each journal box is cast in one piece with the cover plate, insuring rigidity, simplicity and correct alignment. In all but very small blowers the boxes are of the ring-oiling type, lined with Sturtevant white metal, hammered in, and accurately bored.

For maintaining absolutely constant pressure a relief valve or automatic governor may be used. When transferring gases or air at high pressures, stuffing boxes are provided for the shafts; a drain in the bottom removes tar and other distilled liquids.

The Sturtevent high-pressure blower may be driven by a steam engine, motor, or may be belted to a line shaft. A complete line of motors and engines of suitable size and speed are built under the same roof with the blowers, thus combining the advantages of uniformity of material and proportion, and harmonious design. Such conditions are in striking contrast to cases in which the various parts are made in different places and then assembled; the engines or motors, having been built for other purposes and not especially designed for the work in hand. Sturtevant engines completely enclosed and with forced lubrication are particularly adapted for this work.

B. F. Sturtevant Co., Boston, will furnish full details on request.

Waterproofing Transmission Rope.

THERE is a large demand for first-class waterproofed transmission rope for use on drives exposed to the weather. On such drives, when using single ropes, there is often trouble from the stretching and shrinking of the rope, caused by changes in the weather. Sometimes this trouble is quite serious, the shrinkage of the rope pulling down shafting, or at least causing hot bearings. On account of this stretch and shrinkage outdoor drives are usually made on the American system, using a tension carriage, which takes care of the variation length. This increases the cost of the drive, and the rope does not last long because it is affected so much by dampness.

Cotton and other mills, to which additions are made, usually have the new buildings at a short distance from the main plant, and drive across the open space by means of ropes. In designing new plants it is advisable, in many cases, to have the shafts project through the walls and drive along outside of the buildings with ropes. This saves space inside, especially head room, as the shafting can be placed higher and large sheaves can be used for driving. The lighting will also be better. Waterproofed rope makes such an arrangement satisfactory.

There is also quite a demand for cotton gins and cotton oil mills for a transmission rope which will not be affected by the hot, damp summer climate. There is usually a great deal of trouble in these mills when starting up in the fall, as the ropes are left on the drives during the summer and are weakened by the causes mentioned. On rice plantations, it is becoming quite a usual thing to drive the centrifugal pumps by means of ropes, which, of course, are exposed to a great deal of dampness, and are frequently wetted. The same is true of ropes used to transmit power from water wheels.

In paper and pulp mills there is also a demand for waterproofed ropes, as belting will not stand extreme humidity of the air.

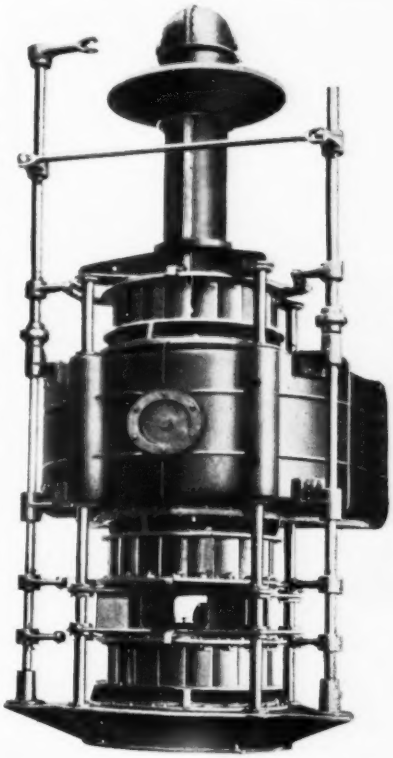
The American Manufacturing Company, 65 Wall street, New York, has been experimenting for a long time to make a waterproofed rope, and the article now being introduced is the result of many experiments. In testing this rope, it has been hung in the river for long intervals, to determine its waterproof qualities, and has been run on the company's outdoor drives more than a year. One of these drives consists of ten 1¾-inch ropes, running almost the full length of the roof of a four-story building 225 feet long, which is on the water front of the East River. After running for sometime, the ropes become perfectly smooth and highly polished. The waterproofing fills the jaw of the rope, preventing the accumulation of moisture in the crevices, and this waterproofing being elastic remains in place, even while the rope is running around the sheaves. The waterproofing adds about two per cent. to the weight of the rope, which lasts as long as standard transmission rope, for in addition to the waterproofing it is thoroughly lubricated internally with flake graphite. The ropes run on the roof drive show no more

wear than ropes in the mills which have run for the same length of time, under the most favorable conditions. On its machines the American Manufacturing Company can make coils of transmission rope 10,000 feet long without a splice.

Hydro-Electric Installation at Sewalls Falls, N. H.

AN interesting problem in the utilization of a water power with a small fall and large variation of head for the production of electric current has been skillfully solved in the design of two 900 horse-power turbines which the Allis-Chalmers Company has built and is now installing at Sewalls Falls, N. H., for the Concord Electric Company. The first installation will consist of two complete hydro-electric units, each composed of triplex turbine water-wheel and a direct-connected alternating current "Bullock" generator, a motor-driven exciter set, turbine governors and electrical synchronizers. As the current is to be used chiefly for lighting purposes, and possibly in connection with other sources of power generation, it is necessary to have the speed of revolution for the wheels and generators constant, even though the amount of developed power might differ under different heads. Ordinarily the stream produces a fall which gives a net working head of 16 feet. In times of flood, however, the water backs up in the lower channel so as to reduce the working head to 12 feet.

To secure the desired results the Allis-Chalmers Company has designed the turbines, each with three sets of runners and gates complete, the three sets being arranged one above the other on a vertical shaft. The three sets of runners are all connected to the tail race by means of draft tubes, so as to derive the full energy of the water, due to its actual head, from each of the runners, no matter what its relative or actual position may be upon the saft. The lower runner of each wheel has a draft tube by itself, while a single tube of larger dimensions carries off the discharge water from from the two upper runners. The turbines are of the Francis central discharge type. The three runners on each wheel are each of equal size, form and capacity; but they do not all discharge in the same direction. The lower one discharges downward into an individual concrete draft tube. The upper runner discharges downward and the middle one upward, both into a separate concrete draft tube, which joins the lower one at the bottom of the tail race. The reactions from these two runners practically balance one another, while the reaction from the discharge of the lower runner, being upward, tends to lift a portion of the load on the turbine shaft. This effect is



considered negligable in the turbine design, but provision is made for using the pressure due to the head of water to actually carry a considerable part of the weight of the turbines and the generators at all times. This is done by admitting the water of the flues into a space directly under the second runner of each turbine, where it exerts its pressure upward against a circular plate which forms a revolting piston. The water will carry about one-third the weight of the rotating parts. The other two-thirds is car-

ried by a thrust bearing supported by the castings of the turbine.

The bearing is made of generous proportions so as to operate safely without oil under pressure for lubrication. The lubrication is, in fact, provided for in an ingenious manner, which appeals to one as being as effective as it is simple. A well is formed outside the bearing rings and this is filled to a suitable height with oil. The oil flows to the inner part of the bearing through suitable holes, passes through the bearing, guided by proper grooves, and is returned through holes to the well. The circulating action is continuous as long as the wheel is in action, and it is automatic. At two points below the thrust bearing the shaft is kept in line by steady bearings carried by portions of the wheel castings. he wheel castings are self-supporting besides carrying the weight of the rotating parts, one section being built on top of the other, and each provided with four stout columns to carry the weight. The castings are steadied and held against vibrations and side strains by having certain parts carried over the walls of the draft tubes. These wells are of concrete and the draft tubes are also of concrete, the whole—walls and tubes—being built as one solid structure of monolithis character.

The wheel cases are all divided so as to permit of dismantling without disturbing the shaft or generator parts, and are put together with machined and ground joints.

The shaft itself is in two parts, coupled together just below the generator. The runners are of non-corrosive bronze, each cast in one piece. They are 55 inches in diameter. Surrounding each runner are the gates which admit the water to it and control its speed. Outside the gates of each runner, and reaching around it so as to admit water to all parts of the periphery of the wheel at once, is a space ample for that purpose.

The gates are composed of movable guide vanes and are so constructed that when open they admit a full head of water with but little interference, and, when closed, totally exclude the water. They are all connected by links to a common gate ring and arranged so that a minimum of power is required to operate them.

The operation is through two countershafts standing parallel to the main shaft. They are each provided with a crank at each set of gates, and the cranks are connected to the gate rings by links. One-eighth of a turn of the shaft completely closes the gates. An energy of not more than 12,000 foot-pounds is all that is required for this operation.

This power is supplied by the governor for each wheel.

The governors are placed on the generators. They are of the Allis-Chalmers Standard type of self-contained oil pressure hydraulic governor. The design of this governor is such that no changes in arrangement will need to be made should three or more units be added to the plant. Such additions are not unlikely after two or three years. The permissible variations in speed under sudden variations of load are shown in the following table:

Variation of load per cent.	Permissible variations in speed.
25%	Not over 2% in 1.5 seconds
50%	" " 4% " 2 "
75%	" " 6% " 2.5 "
100%	" " 8% " 3 "

Each governor is driven from a horizontal shaft running under the floor, which takes its motion from the main shaft of the turbine through the medium of a bevel gear.

The bevel wheel on the main shaft is formed by attaching a toothed rim to the outside of the collar of the coupling which joins the two portions to the shaft. A "Morse" silent chain gear connects the governor to the horizontal shaft and drives the governor. The chain is case in.

The speed is regulated by sensitive fly balls working against knife edges, and the actual control of the gates is accomplished through the agency of oil under pressure operating through the medium of a piston controlled by a pilot valve. These regulators are so constructed as to eliminate "hunting," and insure very close regulation. The governors are so arranged that they are under control electrically from the switchboard, and synchronizers and motors for controlling the governors form a part of the outfit of the station. This makes it possible to increase or diminish the speed of either of the wheels or to shut down

units from the switchboard in case of an emergency.

The wheels will each produce 900 horse-power with a 16-foot head on a consumption of 620 cubic feet of water per second, or 625 horse-power at 12-foot head with a flow of 650 cubic feet per second. Working at full gate they are expected to economize 78 per cent. of the power of the water, ori more, and to give 80 per cent. return at three-fourth gate. At half-gate they are expected to economize 75 per cent. of the power of the water. They operate at 100 revolutions per minute.

Standing directly over the turbines with their stator parts supporte don the generator room floor are the two generators, one for each turbine. The rotor shafts are direct-coupled to the shafts of the turbines and from the upper parts of the turbine shafts. The weight of the rotors is carried by the thrust bearings of the turbines; but they have a steady bearing above the coupling to keep them in line.

The generators are of the Allis-Chalmers "Bullock" vertical water-wheel type, with upper guide bearing supported in a housing bolted to the stator. The stator or armature rests on a substantial cast iron ring supported by the foundation. The revolving field consists of a cast steel spider securely keyed to the vertical shaft and provided with dove-tail grooves in its rim for holding the laminated pole-pieces, which are secured in place by tapered steel keys. The field coils are wound with copper strip bent on edge.

Each generator can deliver 500 kilowatts at 2,600 volts, 3-phase, 60 cycles, 111 amperes per line. The speed is 100 r. p. m., the revolving fields have 72 poles. The fields are wound for separate excitation at 129 volts, and the generators have an efficiency of 94 per cent. at full load, 93 per cent. at three-quarters load, and 91 per cent. at half load. They are capable of meeting the usual high guarantee of the Allis-Chalmers Company regarding heating and will stand a 100 per cent. momentary overload without injury.

The armatures have a three-phase winding of heavily insulated coils, capable of standing a 5,000 volt puncture test between coils and frame. The field insulation is tested with 1,500 volts, applied between the coils and field cores or spider. The supporting yoke for the armature core is of open construction, and since the core itself is provided with numerous ducts or air channels, the ventilation is very thorough.

For exciting the alternators, a motor-generator set consisting of a 75 h. p. induction motor coupled to a 45 KW direct current generator is provided. The induction motor is wound for 2,600 volts, 3-phase, 60 cycles, and the generator for 120 volts; the full load speed is approximately 680 r. p. m. Both machines are mounted on a common bed plate and the set has three bearings, two of which are carried in end housings bolted to the stator yoke of the induction motor.

Stow Electric Emery Grinder.

THE Stow electric emery grinder shown herewith has an exceptionally wide range of speed, and furnishes every conceivable speed between the highest and lowest points. A fraction of a turn of the handwheel on top of the machine will make

a corresponding change in the speed of the motor, thus enabling the operator to get approximately the right speed for the size of emery wheel he is using, but just the right speed. It is the simplest in construction of any variable speed motor—no controller or rheostat being used.

Two wet or two dry wheels can be used, or a dry wheel can be placed at one end and a wet one at the other.

The motor is started and stopped by turning the small lever on the motor to the

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Two wet or two dry wheels can be used, or a dry wheel can be placed at one end and a wet one at the other.

The motor is started and stopped by turning the small lever on the motor to the

right or left, while speed variation is obtained by turning the handwheel on top of the motor. The entire outfit is carefully proportioned, and as the base is large and the running parts carefully balanced there is no appreciable vibration.

The Stow Manufacturing Co., Binghamton, N. Y., will furnish full details on request.

Pelton Turbine Water Wheels.

THE Pelton Water Wheel Company, San Francisco, is about to place on the market a new and improved type of turbine wheels, to be known as the Pelton-Francis. As is generally understood, the Pelton wheel, of the impulse type, is a tangential wheel, adapted to heads from twenty-five feet and upwards.

The prevailing tendency of the electrical manufacturers towards large units and high speeds has encouraged the development of the highest grade Pelton wheel units, built with particular reference to absolutely continuous service twenty-four hours a day and 365 days in the year, even for the largest units. Constructions of 10,000 horsepower capacity have now been in satisfactory operation for several years, and are being constantly called for to meet the increasing size of electrical equipments. To anticipate a demand for a high head and large capacity turbine, and to cover a wider hydraulic field, this company has obtained the services of an engineer of wide experience in this class of work, who with the engineering staff of the Pelton Water Wheel Company, has designed the type of wheel above referred to. This consists of a modification of the familiar Francis type of turbine, so well known in this country, Germany and Switzerland, with which is combined some of the special principles of the heretofore well-known Pelton system. Preliminary tests show a remarkably high efficiency, while the design and construction are exceedingly simple and reliable.

The Pelton Company is now prepared to furnish complete estimates and specifications covering the Pelton-Francis turbines for all water pressures, and in connection with the Pelton wheel, is enabled to meet to the best advantage any conditions of head, speed and power. A recent order for Pelton wheels is that of the Yukon Consolidated Gold Fields for two complete Pelton units operating under a head of 650 feet, each wheel being direct-connected to a 600-kilowatt 450 revolutions per minute, generator, provided with an overload capacity of 1,200 horse power each. The power will be transmitted electrically and used in connection with dredging work on the Yukon River.

Another order is that of the Empire Electric Power and Irrigation Company, of Empire, Colo., who will install under a head of 560 feet a Pelton wheel of 1,000 horsepower capacity, direct-connected to a 450 revolutions per minute generator. The exciter will be mounted on the end of the alternator shaft. Power will be transmitted to the mines and mills in the vicinity of Empire, Colo.

The Pelton Company is letting contracts for its new works in the Mission district of San Francisco, which are to be much larger and equipped with the latest and best tools, and expects to be established there by July 1st of this year.

NEWS SUPPLEMENT

Personal.

—Howard K. McLean, for a number of years general superintendent of the Link-Belt Machinery Co., is now associated with the H. W. Caldwell & Son Co., Chicago, as consulting engineer.

Industrial Notes.

—The New England office of Warren Webster & Co. has been removed to 1108 Penn Mutual Bldg., Boston, where more commodious quarters have been secured.

—The Bates & Clark Co., Seattle, has recently ordered a 250 kilowatt type "AK" generator with exciter and switchboard from the Allis-Chalmers Co., Milwaukee.

—The B. F. Sturtevant Co., Boston, has recently received orders for generating sets from A. M. Lockett & Co., Ltd., Alta Loma, Texas; and the Post Pipe Co., Texarkana, Texas.

The Bruce Merrian Abbott Co., Cleveland, have recently purchased Allis-Chalmers electrical machinery, consisting of a 62½ kilowatt type "HI" generator and two 30 kilowatt type "H" generators.

—The Wisconsin Engine Company, Corliss, Wis., has acquired by purchase the entire plant and equipment, including patterns and drawings, of the Brown Corliss Engine Company.

—S. C. Weiskopf and Eugene W. Stern have formed a co-partnership as consulting engineers under the firm name of Weiskopf & Stern, with offices at 68 William street, New York.

—The American Graphophone Co., Bridgeport, ordered recently a number of Allis-Chalmers motors, types "N" and "B," ranging from 7½ to 25 horse-power, to be installed in the works at Bridgeport.

—The ore roasters of the Atikokan Iron Co., Port Arthur, Ont., are to be equipped by the B. F. Sturtevant Co., Boston, with a complete induced draft apparatus consisting of two large steel plate engine driven fans.

—The American Institute of Mining Engineers, who for the two days preceding had been in annual session at Bethlehem, Pa., were on Saturday, February 24th, entertained by the Ingersoll-Rand Co. at their works at Phillipsburg, N. J.

—The Mead-Morrison Mfg. Co., and the Rawson & Morrison Mfg. Co., have been consolidated and the business will be conducted under the name of the Mead-Morrison Mfg. Co., with offices at Cambridge, Mass., and New York.

—The Fairbanks Co., New York, announce that they are placing two 5 horse power gasoline (special electric) engines with the McCarty Wireless Telephone Co., San Francisco. These engines will be used to generate the necessary electric force on installations which they are about to make.

—Orders for economizers have recently been received by the B. F. Sturtevant Co., Boston; from the Trimont Manufacturing Co., Roxbury, Mass.; Hamilton Powder Co.; Beloeil, Montreal, P. Q.; Oliver Machinery Co., Grand Rapids, Mich.; Raritan Copper Works, Perth Amboy, N. J.

—The Goldschmidt Thermit Co., New York, have just issued a small pamphlet giving instructions for the butt-welding of pipes and rods by their process. The application of the process has found considerable use in the welding of ammonia pipe lines on the street, as the welding can be done without removing the pipes.

—The Haworth Stone and Building Co., of Haworth, N. J., have recently contracted to build an entire concrete village including a club-house and about fifty bungalows. These structures will be built of concrete blocks made on the Hayden concrete block machine, manufactured by the Hayden Automatic and Equipment Co., New York.

—The Queens County Cement Concrete Construction Co. has recently undertaken to improve the real estate in Richmond Hill, L. I., by erecting on its property a number of concrete block dwellings. They have recently bought from the Hayden Automatic and Equipment Co., New York, a Hayden block machine.

—The Capital of the Standard Roller Bearing Co., Philadelphia, has been increased from $2,000,000 to $3,500,000. This increase in their capital has been required to provide for an enlargement in their factory's equipment. A four-story factory 150x200 feet will be erected immediately for the manufacture of annular ball bearings.

—Trinity Cathedral, Cleveland; the Knickerbocker Hotel, New York; and the Jefferson County Bank, Louisville, are to be completely equipped with Sturtevant heating and ventilating apparatus, consisting in each case of centrifugal fan and steam heater furnished by the B. F. Sturtevant Co., Boston.

—The Otis Elevator Co., Yonkers, N. Y., has recently ordered two 24 ft. x 42 ft. Reynolds Corliss heavy duty type engines, direct connected to two 400 kilowatt Allis-Chalmers engine type generators. The new units are designed to carry light and power loads, and are expected to be ready for operation in June. They will be furnished by the Allis-Chalmers Co., Milwaukee.

—The Pittsburgh Gage & Supply Co., Pittsburgh, report the following concerns among the recent purchases of the White Star oiling systems: Roland Park Elec. & Water Co., Baltimore; Jones & Laughlin Steel Co., Pittsburg; Pennsylvania Railway Power Station, Allegheny; Link-Belt Machinery Co., Chicago; Bullock Electric Manufacturing Co., E. Norwood, O.; International Paper Co., Glens Falls; C. A. Cambrill Manufacturing Co., Ellicott City, Md.; Hazard Mfg. Co., Wilkesbarre.

—The Interborough Rapid Transit Co., New York, recently awarded to the B. F. Sturtevant Co., Hyde Park, the contract for 28 staggered pipe economizers, to serve 26,000 boiler horse-power in the new power plant at 59th Street and 11th Avenue. Each section of the plant consisting of two engines and twelve 600-horse-power boilers, will have eight economizers which provide four square feet of heating surface per boiler horse-power. The size of this economizer installation is indicated by the great number of pipes, 7,840.

—The Sprague Electric Co., New York, manufactures electric winding drum hoists which are meeting a popular demand. Hoists of this style require to be fastened securely to a foundation when in use, but they can be mounted upon a movable platform, truck or car, and thus be made portable between hoisting operations. They are used on boom derricks for raising both the load and the boom; as whip hoists; to raise loads rapidly through a hatchway, or in the open, and on docks, on board ships or in buildings. They can be used out of doors without protection from the weather as they are entirely enclosed and are dust and moisture proof. The controller, can be located in any desired position regardless of the location of the hoist, thus affording the utmost convenience in operation. Standard winding drum hoists are rated for single rope with maximum pull of ½, 1½ and 2½ tons. By multiplying the number of ropes, correspondingly increased ropes can be worked at reduced speeds.

—The Allis-Chalmers Club, Milwaukee, has issued an attractive little brochure containing its constitution and by-laws, which are very complete and concise. The printing of these rules is not, in itself, particularly noteworthy; but it calls attention to a class of organizations that are being formed in connection with some of the largest manufacturing and industrial plants of the country, viz: clubs designed to contribute to the comfort, social intercourse and efficiency of employees. The Allis-Chalmers Co. has established for its office men, superintendents and foremen a well-appointed club, occupying quarters in a former mansion house near the works, where, for a nominal yearly fee, members are given all the benefits usual to such organizations. During the noon-hour a course dinner is served at approximately what the service actually costs, and supper may also be had by those who are obliged to stay late at the office. As the club building stands in a residence district and is easily accessible from all parts of the city, it is kept open every evening for the benefit of members, who make free use of the periodicals, games, etc., contained in the reading room. Nights are also frequently set apart for general receptions and entertainments given separately by members of either sex, the annual dues being devoted to a fund for such purposes.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Blowers.

EXETER MACHINE WORKS, Exeter, N. H.—Well-printed catalogue illustrating and describing their blowers, exhaust fans, ventilating wheels, and hot-blast heating apparatus, giving prices and tables of dimensions, capacities, etc., of each. Also a pamphlet giving a list of concerns using their machinery. 6¼ by 8¼ in.; pp. 32.

Boilers.

ALMY WATER-TUBE BOILER CO., Providence.—Catalogue describing the Almy patent sectional water-tube boilers for steamships, river steamers, yachts, launches and for all kinds of stationary works. Contains a list of purchasers; also illustrations of 225 vessels that they have equipped. 8½ by 6 in.; pp. 70.

Boiler Coverings.

PHILIP CAREY MANUFACTURING CO., Cincinnati.—Pamphlet briefly treating the subject of heat insulation and magnesia coverings. Contains a few views of the many prominent buildings and plants where their magnesia steam-pipe and boiler coverings are used. 6 by 9 in. Also a small pamphlet devoted to their magnesia flexible cement roofing.

Cement Working Machinery.

ALLIS-CHALMERS CO., Milwaukee.—Catalogue No. 129 treating of rock breakers, crushers, dryers, kilns, ball and tube mills, elevators and conveyors. Illustrated. 8 by 10½ in.; pp. 52.

Coke Oven.

UNITED COKE AND GAS CO., New York.—A short treatise on the destructive distillation of bituminous coal, with reference to the United-Otto system of by-product coke ovens. This publication is intended to afford general information of the by-product coke oven and its operation to those not familiar with the subject. It, therefore, avoids details of a technical character. The book is finely printed in two colors and contains many illustrations. 8½ by 10¾ in.; pp. 146.

Condensers.

WHEELER CONDENSER & ENGINEERING CO., New York.—Catalogue illustrating and describing condensers, feed-water heaters, evaporators, centrifugal pumps, air pumps, vertical engines, cooling towers, etc., together with views showing some recent illustrations. 9 by 6 in.; pp. 106.

Drawing Materials.

KEUFFEL & ESSER CO., New York.—A very complete catalogue illustrating and describing the many different styles of drawing instruments and materials, as well as surveying instruments, manufactured by this company, together with prices of each. Contains over 400 illustrations. 6 by 9 in.; pp. 532.

Electrical Machinery.

GENERAL ELECTRIC CO., Schenectady, N. Y.—Bulletin No. 4432 illustrates and describes a prepayment attachment for Thompson recording wattmeters and high torque induction wattmeters; Bulletin No. 4433 treats of rotary converters for railway service; and Bulletin 4435 is devoted to an illustrated description of isolated plant switchboard panels with circuit breakers.

Furnaces.

JAMES V. BURKE, Chicago.—Pamphlet devoted to an illustrated description of the Burke self-feeding, smokeless furnace. Also contains illustrations of many of the buildings in which this furnace is installed. 6 by 9 in.; pp. 40.

Gas Engines.

AJAX IRON WORKS, Corry, Pa.—Catalogue illustrating and describing Ajax gas and gasoline engines, together with a list giving sizes and prices of the same. 8 by 5½ in.; pp. 20.

COLUMBUS MACHINE CO., Columbus, O.—Catalogue devoted to description of their gas and gasoline engines—stationary, portable, traction, pumping and hoisting engines. Illustrated. 9 by 7 in.; pp. 30.

Grinders.

JAS. CLARK, JR., & CO., Louisville.—Leaflet illustrating and describing the "Willey" electrically driven grinders and breast drills. 3 by 6 in.; pp. 16.

GARDNER MACHINE CO., Beloit, Wis.—Catalogue illustrating and describing disc grinders, band polishing wheels, disc wheel circles and sectional wheel chucks. 6 by 9 in.; pp. 20.

Locomotives.

BALDWIN LOCOMOTIVE WORKS, Philadelphia.—Catalogue No. 54, entitled "Record of Recent Construction," illustrating some of the locomotives recently constructed by this company, together with a brief description of each. 9 by 6 in.; pp. 32.

AMERICAN LOCOMOTIVE CO., New York.—Pamphlet entitled "Four-Cylinder Balanced Compound Locomotives." A paper read before the Railway Club of Pittsburg by F. J. Cole, mechanical engineer of the company. Illustrated. 9 by 6 in.; pp. 32.

Lubricating Oils.

A. W. HARRIS OIL CO., Providence.—Well-printed booklet in two colors setting forth briefly the different grades of oil manufactured by this company. 4 by 8 in.; pp. 32.

Lubricators.

GREENE, TWEED & CO., New York.—Illustrated catalogue describing their automatic lubricators for stationary and marine engines, steam pumps, and locomotive and hydraulic elevators. 4 by 7 in.; pp. 48. Also catalogue illustrating and describing their steam specialties. 8 by 10½ in.; pp. 64.

Oil Engines.

AMERICAN DIESEL ENGINE CO., New York.—Catalogue briefly describing the American Diesel engine. Illustrated. 6 by 9 in.; pp. 8.

Packing.

CANCOS MANUFACTURING CO., Philadelphia.—Descriptive catalogue and price list of the many

different styles of packing manufactured by them. 2½ by 5½ in.

Pipe Threading Machine.

LOEW MANUFACTURING CO., Cleveland.—Leaflet illustrating and describing their pipe threading machines. 3½ by 6½ in.; pp. 6.

Pneumatic Hammers.

DAYTON PNEUMATIC TOOL CO., Dayton.—Catalogue containing an illustrated description of pneumatic chipping and caulking hammer, together with testimonial letters from users. Also describes the Gunnell pneumatic rivet-heating forge. 9 by 4 in.; pp. 32.

Power Transmission Machinery.

DODGE MANUFACTURING CO., Mishawaka, Ind.—Large catalogue, bound in cloth, illustrating and describing their entire line of power transmission machinery. Contains much useful information to engineers. 6 by 9 in.; pp. 408.

Pumps.

DOWNIE PUMP CO., Downieville, Pa.—Catalogue illustrating and describing their deep-well pumps and accessories. Gas and gasoline engines are also given a place. 6¾ by 10 in.; pp. 60.

CANTON PUMP CO., Canton, O.—Catalogue 16-B, printed in two colors, treating of the different styles of pumps manufactured by them. Also contains many tables of sizes, etc. Illustrated. 7 by 5 in.; pp. 64.

ERIE PUMP AND ENGINE CO., Erie, Pa.—Catalogue D, giving a brief description, with illustrations, of their centrifugal pumping machinery. 9 by 6 in.; pp. 24.

I. B. DAVIS & SON, Hartford.—Descriptive catalogue of their power pumping machinery in duplex, triplex and quadruplex patterns for a variety of service. Also gives prices, sizes, etc., together with tables of capacities. 7 by 8 in.; pp. 38.

LAWRENCE MACHINE CO., Lawrence, Mass.—Catalogue No. 12, devoted to an illustrated description of their full line of centrifugal pumping machinery. Contains much useful information. Their vertical steam engines are also treated. 9 by 6 in.; pp. 48.

GOULD'S MANUFACTURING CO., Seneca Falls, N. Y.—Catalogue illustrating and describing their pumps for fire service, together with a brief description of the high pressure fire protection plant installed at Coney Island, N. Y. The catalogue is nicely arranged and well printed. 8 by 7 in.; pp. 20.

Rock Drills.

SULLIVAN MACHINERY CO., Chicago.—Bulletin 51-C, describing the results of a test made with the Sullivan plug drill at the Innes & Cruickshank quarry at Barre, Vt. Illustrated. 6 by 9 in.; pp. 12.

INGERSOLL-RAND CO., New York.—Catalogue No. 45, being devoted to an illustrated description of their rock drills for mining, tunneling, quarrying and general rock excavation. Also contains many tables giving much valuable data. 6 by 9 in.; pp. 96.

Steam Engines.

AMERICAN AND BRITISH MANUFACTURING CO., Worcester.—Catalogue illustrating and describing the Greene-Wheelock engine with Hill valve gear for any service. Also contains views showing some recent installations. 10 by 8 in.; pp. 20.

C. H. BROWN & CO., Fitchburg, Mass.—Catalogue illustrating and describing their engine, which is adaptable to all classes of service. Also contains horse-power tables of both simple and compound engines, condensing and non-condensing. 9½ by 7½ in.; pp. 40.

CHANDLER & TAYLOR CO., Indianapolis.—A binder containing four of their bulletins devoted to an illustrated description of their direct-connected, high-speed automatic cut-off, and medium-speed throttling engines and stationary tubular boilers. They are well printed in two colors. 6 by 9 in.

BALL & WOOD CO., New York.—Catalogue illustrating and describing their automatic cut-off steam engines, together with tables giving dimensions of same. 12 by 9 in.; pp. 42. Bulletins 103 and 104 treat of horizontal side-crank Corliss valve engines and "Ballwood" welded flanges for steam, air, gas and hydraulic piping respectively.

Steam Specialties.

GOLDEN-ANDERSON VALVE SPECIALTY CO., Pittsburg.—Pamphlet No. 6, illustrating and describing their valves, tilting steam traps and automatic valves and water columns for railroad service. 5 by 8 in.; pp. 36.

Steam Valves.

CALDWELL-WILCOX CO., Newburgh, N. Y.—Catalogue illustrating and describing their automatic check and stop-valve for high pressure steam, together with tables giving sizes and prices. They also briefly describe and illustrate their triple-acting, belt-driven pump for high pressure, expansion joints, cast steel and iron fittings for high pressure steam, high pressure flexible joints for use with steam, water, air and oil pipe lines; sluice gates, and the Brennan rock and ore crusher.

Turbines.

DAYTON GLOBE IRON WORKS, Dayton.—Catalogue devoted to an illustrated description of the American turbine, together with many testimonial letters from users. 6 by 9 in.; pp. 98. Also a catalogue and price list of spur, iron bevel, bevel pit, and miter gears. 5¼ by 7¾ in.; pp. 52.

Valves.

WESTERN TUBE CO., Kewanee, Ill.—Pamphlet illustrating and describing their valves, together with tables giving sizes and prices of each. 5½ by 6½ in.; pp. 8.

CHAPMAN VALVE MANUFACTURING CO., Indian Orchard, Mass.—Catalogue, bound in cloth, illustrating and describing valves and fire-hydrants and their accessories for all purposes and pressures and in all sizes. Also contains tables giving prices. 9 by 5 in.; pp. 400.

EDDY VALVE CO., Waterford, N. Y.—Cloth bound catalogue, containing an illustrated description of taper seat and parallel seat-valves, check, foot and air valves; sluice gates, indicator posts and fire hydrants. Contains tables giving sizes, prices, etc. 9 by 5½ in.; pp. 256.

IMPROVED MACHINERY

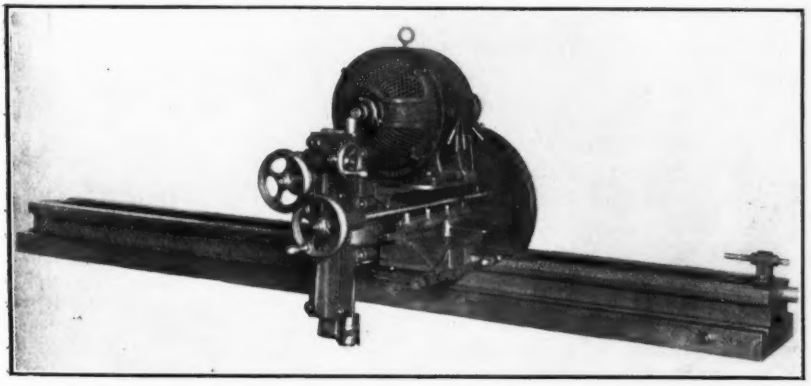
New Processes and Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

Portable Milling Machine.

THE Portable milling machine shown herewith is the outgrowth of a temporary rig designed to do work on a large machine in a stated time and in place, and from that the idea has been elaborated from time to time . It is designed for straight line work, 8 feet long, with a number of surfaces in line but on different planes. Being motor driven it may be taken to the work, and work of such a character that no machine tool built could do as required, for the work can be done after all parts are assembled. The carriage has a travel of 8 feet, with automatic feed; the cross slide has a travel of 12 inches; the vertical spindle a travel up and down of 10 inches. The spindle has a taper hole to receive taper shank mills. The cross slide on the machine has hand feed. The bed is mounted on a sub-base, allowing accurate adjustment by set screws setting up against taper space pieces securely holding the two beds as though in one piece. This sub-base has long slots and projections for securing to the work by clamps or bolts.

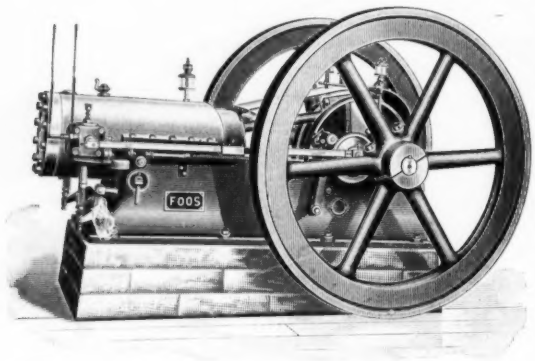
This machine is made by H. B. Underwood & Co., Philadelphia, who will be glad to furnish full particulars about it and its work to anyone making inquiry.



A Foos Engine.

WITH this is illustrated an engine of the regular stationary type as manufactured by the Foos Gas Engine Co., of Springfield, Ohio. The Foos engines are designed on the four-cycle principle, giving an impulse at alternate revolutions of the fly wheels. As nearly all of the working parts are assembled on one side, the operator is enabled to install his engine to the best advantage, even where the space is limited and also to have a free access to the devices for starting and for regulating speed, fuel and air supply and time of ignition. There are no complicated mechanisms about the engine, simplicity being one of its strongest features. The system of ignition, on which depends so much the steady running and effective operation of an internal combustion motor, has been very ingeniously worked out in these engines. The Foos igniter consists of two independent electrodes, the station-

ary and revolving, each carrying a steel contact piece. The revolving blade coming in contact with the stationary spring at each revolution emits a large electric spark, while at the same time, the wiping action of the parts removes any deposit of burnt carbon or scale and prevents the incrustation of the contact edges, which is so often the cause of trouble. This rubbing action of the igniter keeps the points of contact highly polished under all conditions and insures continuous and even ignition. The Foos governor is very simple and compact and is so designed that it may be adjusted to any speed required while in operation and is so placed as to be accessible while still well protected. It is of the centrifugal type and regulates the supply of fuel while cutting out the charges beyond those required to maintain the proper speed. Plain vertical poppet valves, which are positively actuated by a valve gear operating



from steel cams, are used. These assist very materially in the easy handling of the engine. Another distinctive feature of the Foos engine is the system of counterbalancing by means of weights in the form of discs bolted to the arms of the crank shaft, leaving the fly wheels in balance, the latter having no weights cast in their rims and bringing the counterbalancing weights in line with the piston connecting rod, crank and other parts to be balanced. The weights being supported between the main bearings, they are relieved of much strain, the crank also receiving benefit in the same way. The design of the Foos is such as to make all parts of the same easily accessible, it being possible to remove either valve, either portion of the igniter, the cylinder head, piston, etc., without disturbing any other part of the engine or any pipe, fittings or connections.

The material is carefully selected, phosphor bronze being used in all the bearings, and steel forgings for connecting rod, crank, etc. The workmanship is of high grade and the facilities of the Foos factory, which is fully equipped with up-to-date machines and tools, is excellent. This concern also manufactures portable engines, special electric engines, pumps, etc., and will be very glad to furnish any information concerning their line that may be desired to any one addressing the Foos Gas Engine Co., Springfield, Ohio.

Motor Driven Fans.

IT is becoming more evident every day to the observant employer that it is to his interest to render his work-rooms as comfortable as possible for his employees. Comfortable workrooms result in higher working efficiency and a better grade of finished product. This result, together with the fact that the health of the employees is considerably benefited, is sufficient inducement to every manufacturer to give rigid consideration to the question of ventilation. By using a small motor fan is a highly satisfactory way of drawing noxious gases and dust from a workroom and introducing fresh air. Windows alone will not purify air which is quickly contaminated with dust or gases. Accompanying this is an illustration of a motor fan built by the Philadelphia Drying Machinery Co., 6721 Germantown avenue, Philadelphia, Pa. This series of fans, ranging from 16" to 132" in diameter, are named "Hurricane," and may be had either belt driven or direct connected to an electric motor. They are built in a strong and substantial manner, the sheet steel blades being securely riveted to a cast iron centre, after which they are very accurately balanced, so as to insure ease of running. This style of fan wheel has been in successful use for a number of years among representative mills in this country and abroad and is the outcome of practical experience in ventilation,

coupled with the results of many experiments with the object of securing a fan that will move the greatest volume of air with the least possible consumption of power.

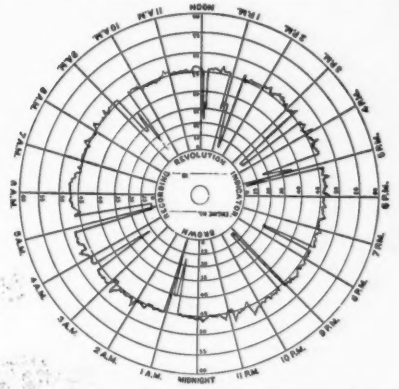
The motors are especially built for the severe service to which fans are frequently subjected and are designed to withstand a large percentage of overload. Where the fan and motor are to be mounted in a dirty or dusty place, or where there is an excessive amount of moisture, the motor can be enclosed, if desired. In order to insure cool running, the bearings are amply large and are well lubricated by means of loose

rings which rotate in reservoirs filled with oil. The bearings are so constructed that the motors may be mounted upside down or at right angles to the position shown in the illustration.

On account of the great variations in temperature and atmospheric conditions generally it is a great advantage to be able to regulate the volume of air moved according to the conditions existing at different times during the day's work. It is possible, however, to obtain a considerable variation in the speed of the fan by means of a speed regulator, which is a part of the standard equipment furnished, and by this means it is also possible to operate the motor and fan at their most economical speed. The latter apparatus is so arranged that the fan can be driven at any desired speed within the range of the speed regulator, which is provided with an automatic release to stop the motor and fan automatically, in case the circuit is momentarily opened. Information on any problem of ventilation or drying will be furnished freely by the makers of the "Hercules" fans.

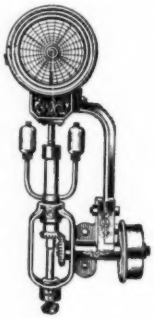
Recording Revolution Indicator.

EDWARD Brown & Son, Philadelphia, Pa., manufacturers of pyrometers and scientific instruments, are placing on the market a new instrument designed to record the speed of engines. The recording revolution indicator, as it is known, is particularly adapted for use on slow running engines, such as Bessemer and blast furnace blowing engines, but it can also be used for high speed engines. Connected to the pen of the instrument illustrated herewith is a float resting on mercury, which is depressed by the centrifugal force of the mercury, thrown out into the revolving arms. A reproduction of a chart taken from one of these instruments in use on a blast furnace blowing engine is also shown. At the present time, the revolution indicator and the revolution counter are used in determining the speed of an engine, and although both are useful, neither fulfills



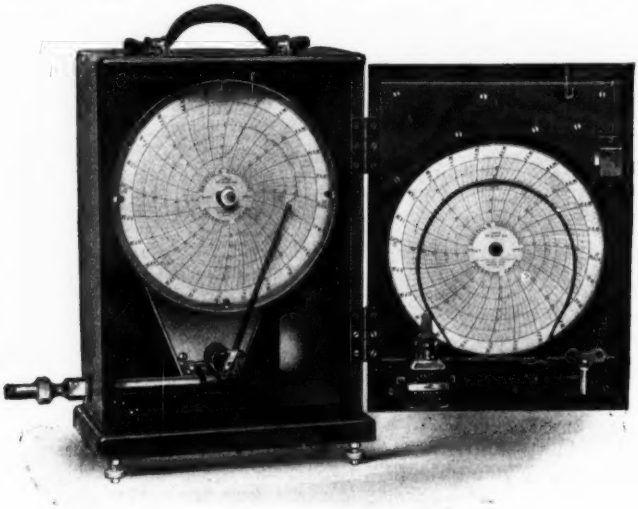
exactly the requirements. The revolution indicator constantly indicates the number of revolutions on a scale, that the engineer may keep the engine at a given speed. With the revolution counter, the number of revolutions of an engine in a certain number of hours, is indicated, and this is reduced to minutes by subsequent calculation, in order to determine the average number

of revolutions per minute. But the result is not accurate, owing to the time the engine is slowed down or stopped. Also the engine may be run at, for instance, 45 r. p. m., a certain space of time, and at 40 r. p. m. afterwards for an equal space of time, and the revolution counter after calculation would show 42½ r. p. m., the revolution per min- for the whole time. In modern blast furnace practice, and in many other operations, it is desirable that the engines be run at a given speed, and kept at that speed. The recording revolution indicator overcomes all these objections.



Portable Recording Gauges.

THE value of recording pressure gauges as a powerful factor in promoting safety and economy has long been recognized, and their adoption has been quite general in mills, factories, water and gas works, electric light plants, power stations, public buildings, blast furnaces, mines, etc., both in this country and abroad. Many users have, however, felt the need of a light, compact, portable recording pressure gauge, and particularly an instrument which is so well made and free from delicate mechanism that an ordinary workman can manipulate it successfully with reasonable care. To cover these requirements the Bristol Company, Waterbury, Conn., has placed upon the market a modification of their well known recording gauge. In these portable gauges the metal case has been omitted, the pressure tube and clock for driving the chart being mounted on a light aluminum back which is, in turn, mounted in a wooden carrying-case designed with special reference to ease in handling and making connections to the source of pressure. For recording pressures which may exceed five pounds per square inch, the type of gauge shown in the illustration is employed. A special flexible connection with unions, is supplied to facilitate connecting to piping at various angles. When a permanent installation is unnecesary, this instrument could be used to advantage, as, for example, on boiler tests, water mains or fire protective systems where a few accurate and continuous records would settle disputes or lead to better service. For gas pressures in outlying districts, mine ventilating pressures, draft or light vacuum, the second gauge is adapted, since



it is capable of recording pressures as low as one-twentieth inch head of water. Connection is readily made by means of a rubber hose to nipple, which projects through the side of case. A simple clamping device is employed to hold the pressure tube rigidly, when gauge is being transported. Those who are interested in the distribution of gas will be particularly pleased to note the production of an instrument which will be of such great assistance in solving their problems. The portable gauges above described weigh about one-third as much as the standard form gauges mounted in a carrying-case, which has been used heretofore, as a substitute. Both forms are furnished with leveling screws to facilitate adjustment of the instrument. Provision is also made for carrying a supply of charts and ink with each gauge.

An Improved Note-Book.

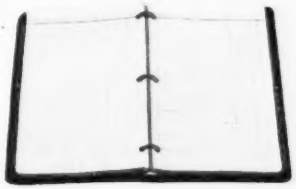
ALL Civil engineers and surveyors keep their notes of survey, which must necessarily be referred to from time to time, and in the old bound book would meet with delay and confusion, when trying to locate previous work. For instance, he must have either a reference by date so that he can turn to the notes taken on that date, or some other reference before he can even locate his notes. The Unimatic book being "loose leaf" or separate leaves, is used largely by surveyors or engineers for their notes. When the notes on a certain mining claim contract, on a certain section, or township are taken, these notes are filed in a post binder or another transfer Unimatic, arranged by date, alphabet, section, or in any convenient method. Index leaves, tabbed either with alphabet or other designation, can be furnished. Thus, should a client ask an engineer about his notes of a former survey, and wish a continuation of that, it is easy to turn to those notes; or, if a new client should wish work done, in which it is necessary to find his base line, corners, or starting point, which he may have already noted in a previous survey, he can get his full description from his old notes very quickly.

Contracts are usually noted in the rough on a note book, and it is frequently those rough notes which are of great value to an engineer as a matter of reference to settle disputes, either in terms, distances or description. These notes may be kept in a Unimatic and afterwards transferred under the heading of the name of a client or caption contract.

In tests, a mechanical engineer keeps his data, which, of course, must be referred to, and when classified for reference, in the future saves many tedious hours of labor in locating them.

Civil and mining engineers are always anxious to find a convenient and labor saving method of filing maps, plats, blue prints, etc. The Reliable file will answer for this purpose, and, when maps are filed in it, they are protected from dust, dirt, rolling, or creasing; in fact, have the appearance of a book of maps bound together, and yet any one can be removed almost instantly, and may be arranged in any order desired.

When the maps are being prepared or in work, it frequently happens that they must be taken from the drawing board and filed away in a drawer or other receptacle pending additional information. A large, loose-sheet holder, made by Sieber & Trussell Mfg. Co., is a most admirable temporary receptacle for these maps and plats.



The papers may be placed in this holder, which will securely hold from one to fifty sheets and keep them free from soiling or contact. In fact, when the engineer appreciates the value and convenience of these devices, he is the warmest advocate of using up-to-date tools for filing or holding his papers.

The Unimatic Memorandum Book is a perfectly flat opening, self-indexing, loose-leaf book, measuring only ½" thick (outside measurement) and having rings ¼" in diameter. It will accommodate 50 sheets with index. It is bound in flexible black seal grain leather, and made small enough for the pocket of the vest, trousers or coat. The rings in the Unimatic form a perfect

circle when closed, and the sheets may be turned easily and freely as in a bound book, yet these rings open simultaneously with a pull on the metal slide, permitting the insertion or removal of sheets at any part.

The Unimatic books are also used in quantities by large firms to distribute among their customers for advertising purposes. Lettered in gold on the side with the name and compliments of the giver, and with sheets specially printed with advertisements or ruled for memoranda, the books make a valuable advertisement. Being loose-leaf, sheets becoming obsolete are removed and new ones inserted, thus the books may be called perpetual.

These loose-leaf books are made by the Sieber & Trussell Manufacturing Co., St. Louis, Mo.

A Combination Furnace.

A COMBINATION furnace has recently been brought out, having on one base, three gas furnaces for various purposes. On the left is the muffle section In this section the flame is projected from the double burners into the chamber encircling the muffle. The lining is so constructed that a rotary motion is imparted to the flame, causing the heat to be distributed evenly over the enclosed space. The products of combustion are drawn off through two small openings at the top of the chamber. The work does not come in contact with the products of combustion, which is desirable when heating dies, milling cutters and other expensive tools.

In the forge section, which is to the right, two burners project the flame into the combustion chamber, which is circular in form. The lining is so shaped as to impart a rotary motion to the flame, which distributes the heat evenly throughout the chamber. This forge is convenient for dressing and hardening small forgings and tools.

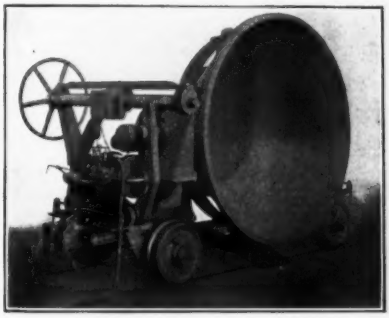
The combustion chamber of the crucible section is in the center, it is circular in form, and the burners are so arranged as to project the flame into the chamber without striking the crucible directly. As a result, a rapid centrifugal motion is imparted which distributes the heat evenly. A vent in the rear allows the products of combustion to pass off. This furnace is well adapted for lead hardening. The lead

bath may be kept at a uniform temperature for an indefinite period with a minimum consumption of gas. For tempering, a crucible similar to that for the lead bath may be filled with tempering oil and a thermometer suspended in the bath enables the exact heat to be maintained for tempering and drawing the work properly. The furnace is made by the Chicago Flexible Shaft Co., 154 La Salle Ave., Chicago, Ill.

New Type of Slag Car.

A NEW and interesting type of slag car has recently been designed by the Power and Mining Machinery Company, Cudahy, Wisconsin. The two views shown here are of a ten-ton slag car, of which fifteen were recently built by the above firm for the new Garfield plant of the American Smelting and Refining Company near Salt Lake City. Some idea of its size can be gained from the over-all dimensions, which are 15-ft. long and 6½ ft. high. Each car weighs 27,000 lbs. empty, or 47,000 lbs. when filled with slag. The bowl is made in five sections, the bottom being made in one piece with four quarters forming the top. This allows of any worn or broken

part being easily replaced. These sections are securely bolted together and tied to a steel supporting ring by key bolts. The supporting ring is securely riveted to the pinion-toothed trunnions which roll on a racked track. The pinion and the rack are both made open between the teeth to prevent their being clogged by any slag which might be spilled into them. The trunnions are rolled by means of a sleeve which is operated through a lever by a 12-inch compressed air cylinder. This cylinder is designed to operate on 60 lbs. air pressure and to tilt and hold the pot in any desired position. The air valve for this cylinder is a simple four-way cock conveniently operated from the side of the car. All the levers and other operating parts are made of steel to reduce the weight of the machine without sacrificing strength. A hand wheel and screw is also provided so that the bowl can be dumped by hand,



should the air supply fail from any cause. When tilted to the extreme position, the side of the bowl makes an angle of 50° with the vertical so as to readily allow the slag skull to slide out. The bowl in dumping is carried to the side of the car by the rolling of the trunnions, so as to dump outside of the rail. An apron in the middle of the truck prevents any drippings from falling on the track.

The entire body of the car is carried on eight powerful springs placed under the front and rear supporting frames and resting on the main bearing boxes. These bearing boxes are fitted with phosphor-bronze bearings which are kept lubricated by removable oil-waste boxes. The two supporting frames are tied together by two 100-lb. rails securely riveted to them, and extended to carry Tower Automatic Couplers. These are provided with the usual side crank attachment for releasing the coupler. One of each pair of wheels is provided with a bronze bushing so that it can revolve on the axle when going around a curve.

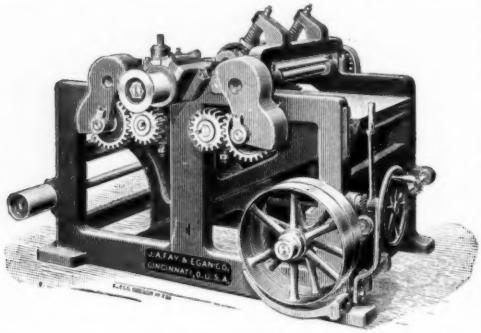
A large factor of safety was used in the design of all the parts of this machine because of the rough usage to which it is put. Special pains were also taken to make

it as simple as possible to operate for the men usually employed for such labor. Slag cars of this design are made in various sizes up to 15 tons in capacity, and with or without the air cylinder.

New Cabinet Smoother.

WE show a cabinet smoothing planer lately placed on the market by the J. A. Fay & Egan Co., called a No. 156 single cylinder cabinet smoothing planer. It has a solid or sectional feed roll for planing several pieces of uneven thickness at one time, and is made in five sizes, 24 to 42 inches wide, by ⅛ to 7 inches thick.

The point about this planer that has been the cause of its great success is the construction of the journal boxes. On other planers having babbitted boxes one has to



chisel out, scrape, re-babbitt, hammer, tighten, and lose much time and labor,—the machine remaining idle all the time—because of looseness of cylinder, and heating and wear of boxes. The number of such planers one has multiplies the trouble and loss just so many more times.

But on this planer the boxes are fitted with patent sectional clamp bearings, barely resting on the journals. They are thin babbitted plates, five to each set of two for each journal of cylinder. The sets rest diagonally to each other, and plates take up their own wear. The minute any looseness of cylinder is felt, or wear of bearings, all the operator need to do is to unscrew bolts, press plates whose edges touch the journal, re-screw, and the work is done. The cylinder never has to be removed from the machine, and no re-babbitting is ever required.

This enables the machine to turn out a class of work that looks as if polished—a sample sent to all those desiring it. Pieces less than 3 inches long can be planed without clipping the ends. The table moves on inclines; there are no stud gears; and the chip breakers rise with the circle of the knives.

Terms and circulars can be had from the maker, J. A. Fay & Egan Co., of No. 212 to 232 West Front St., Cincinnati, Ohio. Also ask for either a general catalogue, or books on hand saws, sandlers, or universal wood-workers.

NEWS SUPPLEMENT

The Engineering Magazine—May, 1906.

Personal.

—R. H. Reed, sales manager for The Reeves Engine Co., Trenton, has severed his connection with that Company after four years of service in that capacity.

—Albert Spies has relinquished the editorial management of the *Electrical Age*, which he held from January, 1904, until the completion of the issue for February, 1906.

Industrial Notes.

—Niles-Bement-Pond Co., announce the removal of their Pittsburg offices to 713-714 Frick Building.

—The Casualty Co., of America has closed all the boiler insurance of the Great Northern, Chicago and Alton, and Chicago, Rock Island and Pacific Railroad Companies.

—Reeves Engine Co., Trenton, announce that their sales department has been consolidated with the office at their works and that they have discontinued their offices in New York and Philadelphia.

—In order to better handle their rapidly increasing business from the Rocky Mountain District, The Power and Mining Machinery Co., Milwaukee, have opened an office at 312—17th Street, Denver.

—George K. Hooper, New York, is building a considerable addition to the plant of the Ashcroft Manufacturing Co., Bridgeport, and is also engaged in doubling the capacity of the plant of the Valley Forge Cutlery Co., Newark.

—The general contract for the erection of two fireproof Dormitory buildings for Syracuse University was awarded to Consolidated Engineering & Construction Co., Syracuse; Revels & Hallenbeck, architects; cost approximately $150,000.

—Owing to increase of business, necessitating larger offices. the Morse International Agency, formerly the Lyman D. Morse Advertising Agency, has moved its offices to the Revillon Building, 19 West 34th St., New York.

—The new thirty stall round house of the Southern Railway Co., Altanta, is being equipped with a complete heating and ventilating system, consisting of fan and steel pipe heater, furnished by the B. F. Sturtevant Co., Boston.

—Dodge & Day, Philadelphia, have issued a pamphlet describing the new factory in Baltimore, recently completed for Wm. Knabe & Co. Manufacturing Co., makers of pianos. The building was designed by Dodge & Day and erected and equipped under their supervision.

—The Peerless Granite Co., Weehawken, N. J. is erecting a large factory for their own use made entirely of concrete blocks. The Hayden concrete block machine manufactured by the Hayden Automatic & Equipment Co., New York, will be used throughout.

—The S. Obermayer Co., preparatory to remodelling its Cincinnati offices, has taken temporary quarters in the Union Trust Co. Building. Extensive improvements will be made, as the company has felt for some time that the capacity of its general offices was inadequate to meet its rapidly growing business.

—The State of Iowa has just passed a law allowing all casualty companies having a capital of $300,000 or over to write more than one line of business. This removes the monopoly formerly enjoyed by one company, thus giving the Casualty Co., of America the benefits of a campaign which has been prosecuted by its president, the Hon. Robert B. Armstrong.

—Among recent sales of economizers made by the B. F. Sturtevant Co., Boston, may be noted the following: Hamilton Powder Co., Beloeil Station, P. Q.; New Orleans Railways & Light Co., New Orleans; Raritan Copper Works, Perth Amboy; Lawton Mills Corporation, Plainfield, Conn.; Haverhill Electric Co., Haverhill, Mass.; Malden & Melrose Gas Light Co., Malden, Mass.

—The Hayden Automatic and Equipment Co., New York, have recently sold to the Ernest Simons Manufacturing Co., South Norwalk, a Hayden automatic concrete block machine and a large equipment for

use in the erection of a plant for manufacture of linens. This plant will be 156 feet long, 56 feet wide and 38 feet in height. It will be erected entirely of concrete blocks.

—Ehrhardt & Sehmer, Saarbrucken, Germany, the European manufacturers of the Morgan continuous gas producer, announces that they have received from a steel works in Bochum, an order for twelve 10 inch producers. They have also an order from Societe St. Gobain in Pisa for six feeding mechanisms, also an order from Milowice Iron Works, Russian Poland, for three 10′ producers.

—The National Carbon Co., Cleveland, have for some time operated gas engines of different makes up to 200 horse power in their various factories. They are now installing in their works at Clarksburg, W. Va. a 600 brake horse power Koerting gas engine supplied by the De La Vergne Machine Co., New York. The engine will be used for general power purposes and will operate on natural gas.

—The D. T. Williams Valve Co., Cincinnati, has perfected arrangements for the erection of a concrete building to cost $125,000. Plans for the building are now being made by a local architect under the direction of D. T. Williams, president of the company. One of the features of the new plant will be a brass foundry for the manufacture of automobile trimmings and one immense garage. The latter part will occupy the entire first floor.

—The Diehl Manufacturing Co., Elizabethport, N. J., have just completed the installation of an electrical equipment of a large manufacturing plant at St. Johns, P. Q., Canada. The plant consists of four 250 kilowatt engine type generators at 150 revolutions per minute, and 100 kilowatts at 260 revolutions per minute. Also a 100 kilowatt motor generator set and about 30 motors varying in size from 75 horse power to 7½ horse power.

—Among recent sales of independent automatic engines made by the B. F. Sturtevant Co., Boston, may be enumerated the following: International Silver Co., Wallingford, Conn.; Tilghman-Brooksbank Sand Blast Co., Philadelphia; Aetna Mills, Watertown, Mass.; The Barnett & Record Co., Minneapolis; The Portland Co., Portland, Me.; Larsen-Baker Ice Machine Co., Omaha; Baltic Mining Co., South Range, Houghton; American Can Co., Lubec, Maine.

—George W. Fowler has established himself at 136 Liberty Street as consulting electrical engineer and power expert. Mr. Fowler has had an extended experience in the electric power field, having been identified with several important installations of standard and special apparatus for the generation and application of electric power. He was formerly with the C & C Electric Co., but more recently engaged in engineering construction. He will devote his attention especially to the application of electric power to manufacturing and industrial establishments.

—Chicago Pneumatic Tool Co., Chicago, have closed their Norfolk office which was located in the Chamberlain Bldg., and will, in the near future, open an office in Richmond, Va. Office located at 602 Empire Bldg., Pittsburg, Pa., will be closed April 1st, and moved to 10 and 12 Wood St. at which point a store building has been secured for the purpose of making a general display of air compressors, tools, etc., and an up-to-date repair department will also be maintained at that point for the benefit of their customers in the Pittsburg district. Their office has been closed at Seattle, Wash., and a new office opened at 84 Sixth St. North, Portland, Oregon.

—In considering the application of electric motor drive many power users defer the use of electricity because of the trouble which seems inevitable in changing over to electric motor drive. Thus many good old machine tools are left to continue on an old plane of inefficiency. Electric motor drive would afford greatly increased output and improved product. The electrical equipment produced by the Northern Electrical Manufacturing Co., Madison, is characterized by the ease of application and convenience of arrangement, location, and operation. For certain classes of work a special type of variable speed motor, described in Bulletin 45 has been developed. Northern multi speed motors are especially designed for application to engine lathes.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Ball Bearings.

Hess-Bright Manufacturing Co., Philadelphia.—Catalogue giving a brief description of ball bearings, together with prices and dimensions. Well printed in two colors and contains many illustrations. 6 by 9 in.; pp. 32.

Belting

Shultz Belting Co., St. Louis.—Small booklet describes the Shultz rawhide belting and packing, together with many useful mechanical formulas and rules. 3½ by 6 in.; pp. 16.

Boiler Coverings.

Norristown Covering Co., Norristown, Pa.—Booklet illustrating and describing asbestos magnesia boiler and pipe coverings. 3½ by 6 in.; pp. 20.

Coal Handling Machinery.

C. W. Hunt Co., West New Brighton, N. Y.—Catalogue 063 illustrating and describing coal handling machinery for power stations, boiler rooms, coaling stations, coal yards, manufactories, etc. 6 by 9 in.; pp. 60.

Condensers.

C. H. Wheeler Manufacturing Co., Philadelphia.—Bulletin No. 7 contains illustrations of condensers, air pumps, boiler feed pumps, low service pumps, pressure pumps, and feed water heaters. 9 by 6 in.; pp. 36. Bulletin No. 8 is entitled "High Vacuum System" and illustrates some of their latest designs with all types of engines up to the most recent steam turbines. 10 by 7 in.

Conveying Machinery.

Williamsport Clutch & Pulley Co., Williamsport, Pa.—Catalogue illustrating and describing a full line of conveying, elevating and power transmission machinery. 6 by 9 in.; pp. 172.

Robins Conveying Belt Co., New York.—Series of single sheets Nos. 1 to 9 inclusive. These sheets are for the purpose of illustrating and describing points which can not be made clear by a mere written statement.

Countershafts.

Mossberg Wrench Co., Central Falls, R. I.—Pamphlet illustrating and describing countershafts and belt shifters, together with a list giving prices and dimensions. 6 by 4½ in.; pp. 16.

Dump Wagons.

Troy Wagon Works Co., Troy. O.—Booklet printed in two colors, illustrating and describing bottom-dump wagons, together with tables giving sizes, capacities, etc. 6½ by 3½ in.; pp. 24.

Engine Indicators.

Lippincott Steam Specialty and Supply Co., Newark.—Preliminary catalogue illustrating and describing the Lippincott engine indicator, reducing wheel and planimeter, steam separator and oil extractor. 4 by 6 in.; pp. 64.

Engine Stops.

Locke Regulator Co., Salem, Mass.—Catalogue containing a complete description, with illustrations, of the Locke automatic safety appliances for steam and electric motors. Also contains a list of the companies who have installed this stop. 9 by 6 in.; pp. 32.

Exhausters.

Sterling Blower & Pipe Mfg. Co., Hartford.—Pamphlet giving a brief description of the many different styles of exhausters manufactured by them, together with lists giving sizes, prices, etc. 4 by 8 in.; pp. 42.

Fans.

Massachusetts Fan Co., Waltham, Mass.—Sectional catalogue No. 50 containing an illustrated description of the Davidson propeller fans for heating, ventilating, etc. 7 by 9 in.; pp. 32.

Feed-Water Heaters.

Benjamin F. Kelley & Son, New York.—Folder descriptive of the Kelley-Berryman feed-water heater and purifier.

Warren Webster & Co., Camden, N. J.—Catalogue illustrating and describing the larger sizes of class "EC" type of feed-water heaters and purifiers for capacities ranging from 500 to 5,000 horse power. 6 by 9 in.; pp. 32.

Gas Blast Furnaces.

Chicago Flexible Shaft Co., Chicago.—Catalogue containing an illustrated description of gas blast furnaces. Automatic heating machines, rotary pressure blowers and flexible shaft machinery are also treated. 6 by 9 in.; pp. 50.

Gas Engines.

Fort Wayne Foundry & Machine Co., Ft. Wayne.—Catalogue giving a general description of the Wayne gas engine with illustrations. 9 by 6 in.; pp. 40.

Gaskets.

McCord & Co., Chicago.—Booklet giving price lists and dimensions of the different styles of gaskets manufactured by them. Illustrated. 4½ by 7 in.; pp. 24. Also a pamphlet illustrating and describing force feed lubricators. 3 by 6 in.; pp. 32.

Injectors.

PENBERTHY INJECTOR CO., Detroit.—Catalogue containing an illustrated description of automatic injectors, auto-positive injectors, ejectors, oil and grease cups, water gages, gage cocks, etc., together with tables giving sizes and prices. 6 by 9 in.; pp. 84.

Jacks.

ACME BALL BEARING CO., New York.—Catalogue illustrating and describing the Acme ball bearing jack. This jack is especially adapted to railroad work. 6 by 9 in.; pp. 20.

Kerosene Engines.

INTERNATIONAL POWER VEHICLE CO., Stamford, Conn.—Catalogue illustrating and describing kerosene engines. 6 by 9 in.; pp. 16.

Marine Motors.

LOZIER MOTOR CO., New York.—Three catalogues illustrating and describing marine motors, motor boats and the Lozier motor car.

Metallic Packing.

STEEL MILL PACKING CO., Detroit.—Pamphlet containing a brief description of plastic metallic packing. Also contains many testimonial letters 5½ by 8 in.; pp. 12.

UNITED STATES METALLIC PACKING CO., Philadelphia.—Well printed booklet illustrating and describing metallic packing for locomotive rods and valve stems. 4½ by 7 in.; pp. 24. Also a booklet devoted to packings for marine and stationary engines.

Oiling Devices.

WM. W. NUGENT & CO., Chicago.—Catalogue No. 6 is entitled "How to Oil an Engine" and contains many useful hints. It also illustrates and describes oiling devices, oil filters, oil tanks and oil pumps. 6 by 9 in.; pp. 48.

Paint.

NATIONAL PAINT WORKS, New York.—"The Review of Technical Paints for Metal" is the title of a pamphlet containing much valuable information concerning paints for metals. 6 by 9 in.; pp. 48.

Power Transmission Machinery.

MINNEAPOLIS STEEL & MACHINERY CO., Minneapolis.—Catalogue D illustrates and describes power transmission appliances and elevator machinery, together with tables giving sizes, prices, etc. 5 by 8 in.; pp. 220.

Pumping Engines.

RIDER-ERICSSON ENGINE CO., New York.—Catalogue illustrating and describing the Rider and Ericsson hot-air pumping engines. Also contains many testimonial letters. 5½ by 8 in.; pp. 38.

Reducing Valves.

MASON REGULATOR CO., Boston.—Catalogue containing a general description of Mason all bronze reducing valves, together with price list Illustrated. 6 by 9 in.; pp. 56. Also a catalogue illustrating and describing their locomotive reducing valves and air pump governors. 6 by 9 in.; pp. 16.

Rock Crushers.

POWER AND MINING MACHINERY CO., Cudahy, Wis.—Catalogue No. 4 treating of the McCully gyratory rock crusher. Elevators, screens, hoists, etc., are also given a place. 6 by 9 in.; pp. 70.

Rope Transmission.

GEO. V. CRESSON CO., Philadelphia.—Catalogue, printed in two colors, on rope driving. Illustrated. 6 by 9 in.; pp. 20.

PLYMOUTH CORDAGE CO. No. Plymouth, Mass.—A well-printed pamphlet containing a treatise on manila rope transmission. Also contains tables showing horse power, frictional data of groove, etc. Illustrated. 9 by 6 in.; pp. 32.

Rubber Belting.

VOORHEES RUBBER MANUFACTURING CO., Jersey City.—Booklet, pocket size, describing mechanical rubber goods, such as belting, packing, hose, valve mats, etc. 4½ by 6½ in.; pp. 112.

Steam Engines.

VALLEY IRON WORKS, Williamsport, Pa.—Bulletin No. 1 illustrating and describing the Lycoming belt driven and direct connected engines. 9 by 6 in.

AMES IRON WORKS, Oswego, N. Y.—Illustrated catalogue describing stationary and portable engines. Horizontal tubular boilers are also treated. 9 by 6 in.; pp. 46.

PROVIDENCE ENGINEERING WORKS, Providence.—Catalogue devoted to an illustrated description of the Rice and Sargent engine. Also pamphlets giving the results of tests of a compound engine using highly superheated steam and the steam consumption at partial loads.

MINNEAPOLIS STEEL AND MACHINERY CO., Minneapolis.—Catalogue illustrating and describing Corliss engines. Also contains many views showing recent installations. The printing of the catalogue is well executed. 9 by 7 in.; pp. 70. Also a pamphlet devoted to horizontal tubular boilers. 9 by 7 in.; p. 46.

Steam Pumps.

NATIONAL STEAM PUMP CO., Upper Sandusky, O.—Catalogue No. 27 is devoted to an illustrated description of the single and duplex pumping machinery and air compressors. 6 by 9 in.; pp. 100.

Valves.

KENNEDY VALVE MANUFACTURING CO., New York.—Illustrated catalogue and price list of the many different styles of valves, hydrants, etc., manufactured by them. 9 by 5 in.; pp. 130.

NEW BEDFORD BOILER AND MACHINE CO., New Bedford, Mass.—Catalogue containing dimensions, descriptions and prices of high pressure valves. Is well illustrated and finely printed. 6 by 9 in.; pp. 24.

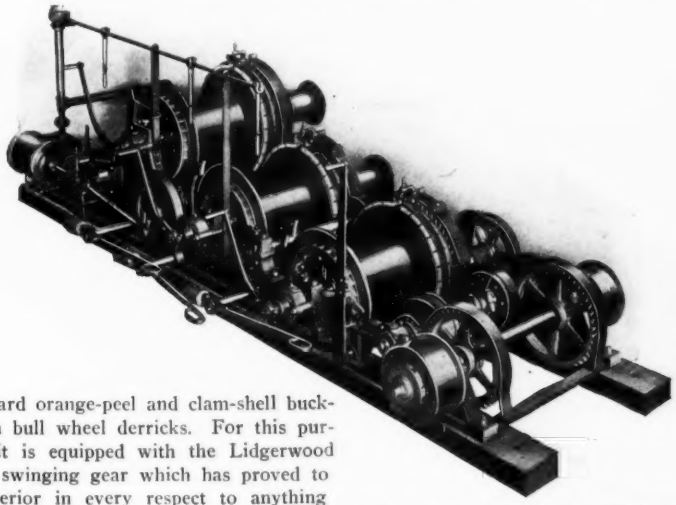
IMPROVED MACHINERY

New Processes and Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers rather than ourselves, are responsible for the statements made.

Three-Drum Tandem Derrick Engine.

THE double cylinder three-drum tandem Lidgerwood hoisting engine shown in the engraving is designed for use where it is desired to operate three hoisting lines or ropes, and needs only one man to run it. It follows closely in its construction the regular pattern standard Lidgerwood two-drum hoisting engine built by the Lidgerwood Manufacturing Company, 96 Liberty Street, New York, with the addition of the third drum, and is particularly well adapted for operating the



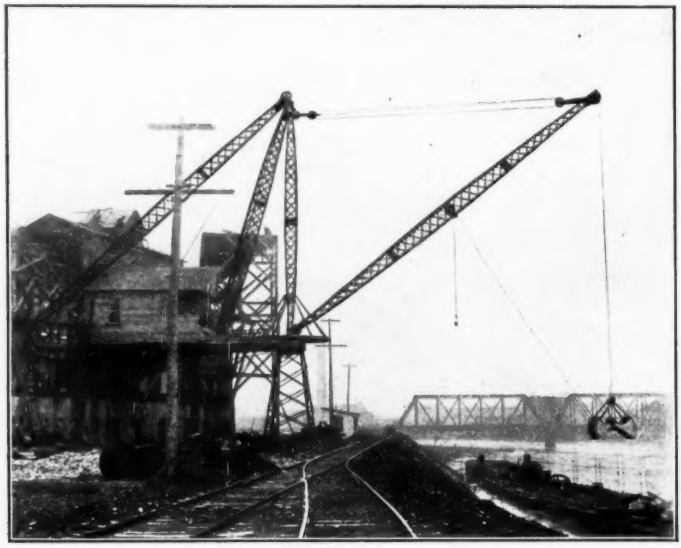
Hayward orange-peel and clam-shell buckets on bull wheel derricks. For this purpose it is equipped with the Lidgerwood No. 4 swinging gear which has proved to be superior in every respect to anything heretofore produced.

An equipment built and erected by the Dobbie Foundry & Machine Company of Niagara Falls and New York for the Buckeye Dredging Company of Columbus, Ohio, furnishes an excellent illustration of the adaptability of this engine for work of this kind. It is planned to elevate gravel from barges in the river to the top of a building where the crusher and screen are located, also to pile sand in the yard, the conditions being that the derrick should be located so as not to interfere with railroad traffic or track between the building and the river, and that the railroad cars may be loaded from either side while the hoist is in full operation.

The derrick is located on a steel tower 10 feet square at the base, 5 feet square at the top and 22 feet high. The 10 x 12 double cylinder three-drum hoisting engine is on the same platform, steam being taken from the main boilers which operate the other machinery. The boom is 80 feet long, of steel construction lattice-work pattern, and the derrick is rigged to handle a 1⅝ yard Hayward clam-shell bucket. The weight of the bucket loaded is six thousand pounds. The two rear drums of the engine are used to operate the ⅞ inch bucket ropes which lead from sheaves at the foot of the hoist direct to the drums. The forward drum is used to operate the boom topping lift which is of ⅜ inch rope and passes over rooster at the top of the mast direct to the engine. The No. 4 swinging gear is employed to operate the

16 foot bull wheel for swinging the boom.

The drums are so arranged that they may be operated independently, or they may all be operated at the same time for hoisting, lowering, or swinging. Each is equipped with a cone friction of wood, a steel band brake with segmental wood lining, and a ratchet and pawl. The cone friction is employed for hoisting the load and the band brake for lowering. When it is desired to hold the load suspended at any particular point, a pawl is used and holds a ratchet cast on one flange of each drum. The drums are each fitted with two independent levers, one for operating the friction and the other for the band brake.



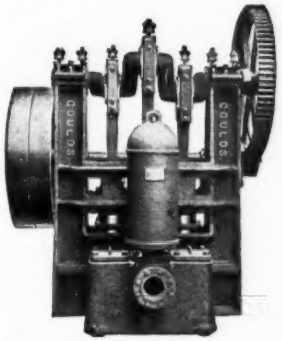
The number 4 swinging gear which operates the bull wheel is controlled by one lever and, briefly, consists of a drum shaft with two gear wheels and two drums, a friction shaft and two frictions and pinions mounted on side stands tied together by two flat steel braces, secured to the bottom of the side stands and countersunk in them, making an independent apparatus which is mounted on an extension of the engine skids, and fastened to the front end of the engine bed plate. It occupies but a small space and adds little to the weight of the engine.

For similar conditions a two-drum engine is sometimes used in connection with a single-drum engine; or a third drum is added to a two-drum engine to operate the three ropes, and a single-drum engine with reversing gear is used to operate the bull wheel. While this arrangement will do some work, it is very tiring to the engineer who then has two engines to operate. His work is practically doubled and the results accomplished at the end of the day are materially less. With the three-drum engine equipped with swinging gear as shown, all the work can be accomplished with one engine and one man to run it. All of the operating levers are so arranged that the engineer can see his bucket all the time, either when loading, in motion or dumping.

A Gould Triplex Pump.

THE pump shown in the accompanying illustration is built by the Goulds Mfg. Co., Seneca Falls, N. Y., and is intended for use in connection with steam plants where compound engines are used with boilers carrying steam up to 150 pounds. It is designed and built on the principle that a continuous action of the working parts produces constant flow of liquid, and in consequence a high efficiency. The photograph shows at a glance the principal feature of the pump, the arrangement of the plungers, which are connected to the crank shaft so that they operate at an angle of

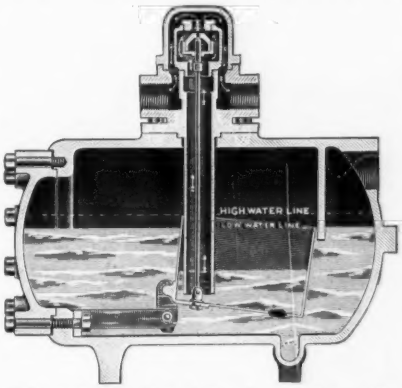
120 degrees apart, thus producing a constant overlapping and following of the liquid pump. This insures a constant flow, and highest efficiency. This pump is for boiler feeding, general water supply, hydraulic elevators, mine pumping or similar requirements where the work is severe and where it is necessary to employ a pump of such construction that it will operate satisfactor-



ily and at a small expense of maintenance. It has three single-acting plungers, attached to connecting rods by means of cross heads which sustain the side thrust of the connecting rods and permit the plunger to reciprocate through the packing without lateral pressure. By this construction the wear of the plungers, glands and packing is reduced to a minimum and the crossheads and pins are readily accessible. The crank shaft is of open-hearth cast steel and runs in ample bearings. All boxes are provided with sight feed oil cups. The shaft has tight and loose pulleys and pinion which engages with the crank shaft gear. The pinion and gear are machine cut and the former are of charcoal iron machine cut from the solid, unless rawhide is desired. For ordinary work this pump is made with iron plungers, cylinder, and glands, rubber disc valves and bronze valve seats. It has large valve area. The base and cylinders are of substantial pattern and are cast in two parts and bolted together. For special service the working parts are made of bronze or other material, depending upon conditions under which the pump is to be operated. It is made with plungers, 1¼" in diameter and 2" stroke, 8" in diameter and 10" stroke, capacity per minute 1.8 to 273 gallons. Made by the Goulds Mfg. Co., Seneca Falls, N. Y.

An Unlimited Steam Trap.

STEAM experts are at present much interested in steam traps which can handle large amounts of condensation and at the same time withstand high pressure. For this service a trap must have large discharge area and rapid valve action. In a recent test the trap illustrated herewith discharged 33,000 pounds of water per hour under 21 pounds pressure, and later 46,000 pounds at pressure of 40. This enormous capacity would be invaluable in large steam plants when heavy condensation in the headers, or "slugs" of water from foaming boilers discharged from the separator sometimes flood the steam trap. This trap is known as the Squires Unlimited. The manner of operation is as follows:—When condensation has reached the high water line, the bucket fills, sinks and opens the small auxiliary valve. Pressure under the



main valve is thus relieved, and the main valve is forced down and open instantly by the internal trap pressure upon its upper surface. The bucketful of water is then discharged. The bucket on rising closes both valves, until the operation is repeated. No wire drawing is possible, as the trap is always wide open or closed tightly, and as it opens and closes without jar there is no danger of starting joints or pipes to leakage in vacuum pan or other work.

Aside from the valve mechanism, which works equally well at all pressures from zero to 250 pounds, this trap contains other mechanical features which are worthy of mention. It has few moving parts, and when once put in position does its work without further attention. The valve and

seat are high above the water level, away from dirt and sediment which enter with the water. They may be replaced or inspected in two minutes time by unscrewing cap, quite an improvement over the older types, which must be taken apart, the piping disconnected and new gaskets made.

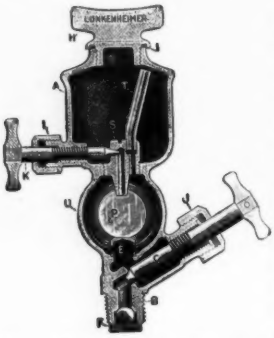
The trap body is designed to withstand great internal pressure, and each one is tested to 1,000 pounds hydrostatic pressure before leaving the shop.

The Strong, Carlisle & Hammond Co., of Cleveland, Ohio, send the trap to prospective customers on 30 days free trial.

Gas Engine Lubricator.

THE Lunkenheimer Co., Cincinnati, Ohio, has issued a very interesting pamphlet descriptive of their "Premier" gas engine lubricator, recently placed on the market.

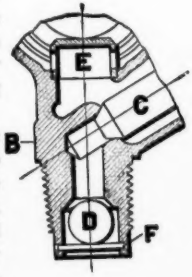
The cup is made entirely of the highest grade of bronze composition, the construction is very compact, and the general design will undoubtedly appeal to users of this class of goods. The cup was constructed not only with a view to positive and proper lubrication, but also to withstand severe service. It is practically made and nicely finished, presenting quite a neat appearance, and there is positively no liability of its shaking to pieces owing to the jarring of engine.



The filling hole is very large, which users will undoubtedly appreciate, especially when the cups are applied to motor boat engines, as it permits the use of a filling can having a large spout. To positively insure a tight joint between the filling plug H and top of cup, the plug is provided with a lead washer I, which material, being softer than the brass upon which it bears, will readily conform to any irregularity that might exist between these bearing surfaces. It is almost impossible for this gasket to wear out, owing to the slight friction it is subjected to, but should the same wear, it can be quickly and easily renewed.

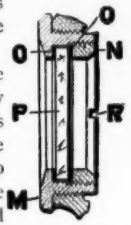
To permit of refilling the cup while the engine is running, the valve C has been provided, which one can be quickly closed and opened. The stem of this valve is well packed by means of the stuffing box J.

The regulation of the feed is accomplished by means of the valve K. This valve is provided with a fine needle point, and the thread on the stem is also of fine pitch, hence a very close adjustment can thereby be obtained. The stuffing box L not only serves the purpose of preventing leakage around the stem valve K, but by means of it, the proper amount of friction can be brought to bear on the stem, and thereby prevent the unsetting of the valve.



The object of the tube T, within the cup A, is to equalize the pressure on the oil, which permits the oil to drop by gravity through the sight-feed and thence to the cylinder.

To provide against the back pressure (which will more or less escape past the pistons) interfering with the proper formation of the drops in the sight-feed and causing the oil to spatter around the glass, the shank B, of the cup, is fitted with a large ball check valve D. It has been found, however, that where the back pressure is unusually great, as in engines with worn piston rings, that the ball check does not entirely remedy the trouble. To meet this condition, a baffling cap E has been provided just above the valve C.



The gases escaping past the ball check D, are effectually muffled and diffused by means of the cap E, and hence the drops form perfectly, drop freely and steadily, and the sight-feed glasses never fill up.

Another important feature is the practical construction of the "Bull's Eye" sight-feed. This consists of the holder M, retaining ring N, two rubber washers O, O,

IMPROVED MACHINERY

New Processes and Appliances

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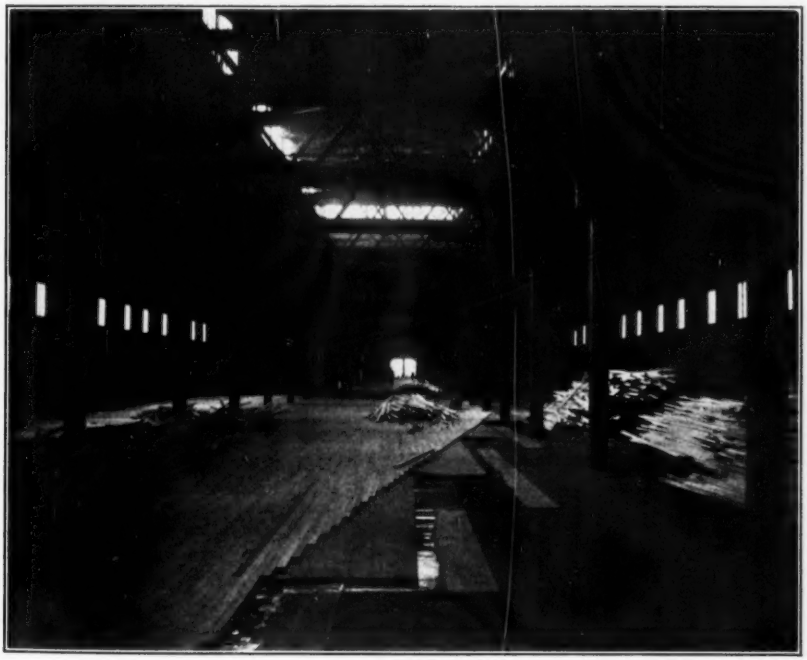
Importance of Waterproof Floors in Mill Construction.

THE importance of waterproof floors in mill construction is not so much in the extra 5% insurance allowance as in the saving from loss by water in the event of fire. The losses by water are considerably in excess of losses directly by fire in protected mills and factories. Each floor can be and should be practically independent of and yet a protection to each other floor in its capacity to hold water to the depth of several inches, and lead it off through properly arranged scuppers and leaders. Sprinkler systems should not be installed without a waterproof floor under them. The fire underwriters and insurance companies are the strongest advocates of waterproof floors. A waterproof floor is a most valuable insurance and factor of safety in mill construction, or for that matter any other building, especially when it is considered that the cost of such floor is almost negligible as compared to its value and the cost of the structure. The difficulty in obtaining watertight floors in mill construction has been chiefly in using improper waterproofing materials. Experience shows, for example, that tar and tar paper, when used as floor interlining soon dry out when open to atmospheric and temperature



FLOOR OF PIER, NORTH GERMAN LLOYD S. S. CO.

changes, become brittle and go to pieces earlier than when used in almost any other condition. Such materials soon fracture away from the nail-points in cold weather, allowing water to pass through. Tar and tar paper, and the ordinary building and asphalt papers, are not reliable and durable waterproofing materials for such work. The same objection applies to mastic or asphalt floors, which in exceptional cases, may effectively serve for some time, but fail when the test comes. A mastic or asphalt floor draws away from columns and walls, and when made soft enough not to harden and crack in winter, becomes too soft in summer to bear the load of traffic or stored merchandise.

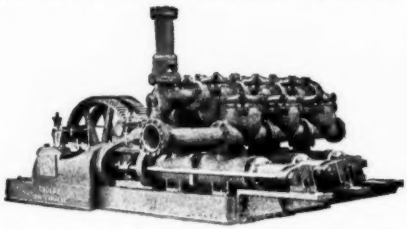
The most efficient and modern method under all conditions is a waterproof membrane interlining under the top or wearing surface. The material now being extensively used for such purpose in important work is the "Hydrex" waterproof felt, a very tough and elastic felt especially made for waterproofing and so treated after saturation as to be in itself absolutely impervious to water. Two sheets of the felt are customarily used, cementing the sheets together with an elastic (hot) compound. As each plank of the top flooring is being laid the hot compound is spread under it and over the felt already in place, so that the nail points are filled in tightly and snugly.

The accompanying photograph shows the two layers of felt in waterproofing the floors several years ago of the new steel and concrete piers of the North German Lloyd Steamship Company. One of the chief points of superiority in the materials is their exceptional pliability and elasticity. A sample of the felt hung up in doors or out remains tough and flexible long after a sample of tar paper or ordinary building paper has dried out and become useless. The felt is being used for waterproofing the Pennsylvania Railroad tunnels under New York City. It was specified several years ago for that work after severe competitive tests for strength, flexibility and durability. It was originally made to resist underground waterproofing conditions, but it is now extensively used in a single layer for a waterproof lining under roofs, slate, tile, stucco, clap boards, etc. It is made by the Hydrex Felt & Engineering Co., 120 Liberty Street, New York, who originated the "Hydrex" membrane method of waterproofing, which has been used in some of the largest and most important underground work in the country.

Goulds Mine Pump.

THE Goulds double-acting triplex plunger mine pump was originally designed for mine service, but has since been adopted for various duties. It has proved particularly effective in accumulator work or where constant high pressures combined with large capacities have to be maintained. The construction is such that the pump can be taken to pieces and lowered through an ordinary mine shaft, and when assembled requires but little head room. It is adapted to stand continuous hard service under the most exacting conditions, all working parts being easily reached from the outside without dismantling the pump.

The frame consists of two heavy cast iron bed plates, doweled together and supporting the main bearings, guides, cylinders



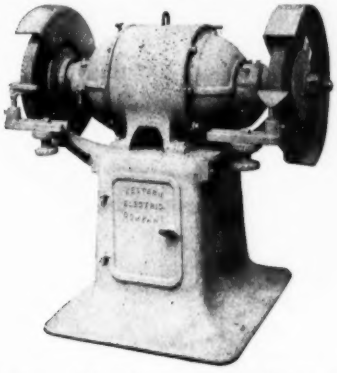
and all working parts; the crank shaft is of forged steel in two pieces, each having a single throw with a gear at the inner end to carry the centre crank pin; the crank shaft bearings are babbitted, hammered and bored to secure perfect bearing surface, and have wedge and screw adjustments of special construction to keep the shafts in perfect alignment. The pinion shaft bearings are of the best Babbitt metal; the double gears are of charcoal iron, the pinions being steel forgings, both machine cut from the solid; the crossheads are fitted with adjustable shoes which are babbitted and run in bored guides; the connecting rods are of steel with forged steel strap and wedge adjustment with bronze boxes at each end; the six cylinders are all of separate charcoal iron castings fitted with bronze linings; the plungers are of hard

cast iron carefully machined and ground true and smooth, outside packed; the glands are of hard cast iron and easy of access for adjusting and repacking. The valve boxes are of separate charcoal iron castings, each containing a set of suction and discharge valves which are readily examined by the removal of the valve box covers. Power for driving may be applied at either side of the pump. For electric or other high speed motor power intermediate gearing and auxiliary shaft are used and can be supplied to order.

Further particulars may be had from the Goulds Manufacturing Co., Seneca Falls, N. Y.

Motor-Driven Emery Grinder.

WE illustrate a view of a motor-driven emery grinder built from some new designs of the Western Electric Company, Chicago. Mechanically the design is very complete in that the motor is entirely encased and dust proof, while at the same time it is possible to examine the internal parts of the motor by means of removable covers which allow easy access to the com-



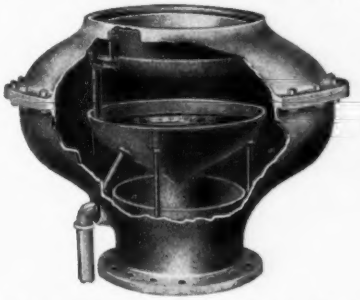
mutator and brushes. The bearings are of special construction to prevent the emery dust from reaching the bearing surface.

Electrically the motor is designed to permit of wide speed variation by shunt field control, thereby insuring maximum efficiency of operation at all speeds. This feature is provided in order that the speed may be increased as the diameter of the wheels is lessened by wear. The starting box and speed controllers are conveniently placed within the pedestal, thus bringing all connections under cover and avoiding the possibility of difficulty by contact with live conductors.

The design is very liberal and consequently the dimensions of the complete outfit are somewhat larger than usually found, and in this connection it is interesting to note that sufficient space has been allowed between the wheels and the motor frame for the operator to stand when desirable.

Hoppes Exhaust Head.

IT has usually been the custom to make exhaust heads of galvanized sheet metal, but the corrosive action of the atmosphere and the water of condensation is so destructive that it has been found best to make these machines of cast iron. The Hoppes Manufacturing Company, Springfield, Ohio, were doubtless pioneers in this departure and have for a number of years made exhaust heads of cast iron. The largest size of head furnished by this company



of this material was for 14" pipe, larger sizes being built with cast heads and steel plate shells. To meet the requirements of the trade however they have designed a new head which they build in sizes for pipe from 14" to 48", this machine being shown by the accompanying cut. The entrained oil and water is caught in this head by troughs partly filled with water, as is clearly shown in the cut. The cone in the center deflects the current of steam and prevents excess moisture from passing direct to the atmosphere and an annular groove at the top prevents condensation from overflowing and running down the outside of the head and pipe. The intercepting trough system is the same as used in the Hoppes steam separators and oil eliminators.

Ramsay Crank Mechanism.

A NEW corporation, known as the Ramsey Engine Company, with offices in the Bullitt Building, Philadelphia, has been formed for the purpose of exploiting the

Ramsey Crank mechanism, which is a device applicable to all single-acting engines. A number of advantages are claimed for this device, and it is stated that in a series of tests made under supervision of the University of Pennsylvania on a vertical gasoline engine having a 9 inch cylinder and 7 inch crank a total efficiency of 25.9% was obtained, which is very extraordinary for an engine of such dimensions. The officers of the Ramsey Engine Company are: President, Robert H. Ramsey, who is the inventor of the Ramsey crank mechanism; Vice President and General Manager, Russell H. Ramsey; Secretary and Treasurer, R. Howard Eisenbrey. Mr. Russell H. Ramsey and Mr. Eisenbrey were formerly connected with the Harrison Safety Boiler Works, of Philadelphia. It is understood that the new company will not manufacture engines, but that it will issue license rights to engine manufacturers.

Time Keeping with Checks.

THE American Railway Supply Co., 24 Park Place, New York, has sent us a description of the time system in a foundry using their time checks. There are in use duplicate check boards very neatly made with pins projecting about ¼", and under each pin is marked the number corresponding with the check to be hung there. The object of duplicate boards is that one checkboard may be arranged during the day for use the next morning, so that a clerk will not have to remain to arrange the checks turned in in the evening when the men go home. Every man calls at the time-keeper's window for his check before going into the foundry. At 7 o'clock the doors are closed and anyone coming later must pass through the office. Each of the departments also is provided with a board on which to hang the checks during the day, so that the foreman of the department can always tell how many of the men are at work. At quitting time, no matter when this may be, the men take the checks and report at the timekeeper's office the number of hours they have worked. These checks are then dropped through slots into a draw which has compartments arranged from 5 to 15, running in halves, and the checks are dropped into the compartments corresponding with the number of hours worked. The time book is kept by number as well as name, the man's number preceding the name and running in consecutive order. In the morning a clerk takes the drawer with its various compartments and credits each man with the number of hours according to the department from which his check is taken. The arrangement is very simple and it is claimed that the time of 500 men can be made up in one-quarter the time required by the clock system. The advantage that the clock system has over the check system is that every man records his own time, and if he makes an error he knows he is responsible. There is also a system of checking such names as start to work either before or after seven o'clock, so that the office knows exactly the number of hours a man has worked and can detect it at once if the correct time is not given.

Handling of Coal Screenings.

IN many coal yards the handling of anthracite screenings which have been taken out of the coal before delivery by the screens above the bins has become a very serious problem. This problem is met in a number of ways, the most satisfactory being the use of an inclined belt conveyor or of bucket elevator for taking the screenings from the ground level to a shaking screen situated at the top of screen pocket, a distance usually of about 50 feet. Such a problem was recently before the Wellington Wild Coal Co., Charlestown, Mass., and it was solved by the installation of a Robin's bucket elevator and a system of screens that was designed by the Robins Conveying Belt Co., of New York. A concrete pit was constructed to receive the hopper which feeds the screenings to the bucket elevator. The top of this hopper is a few inches above the ground level. The material is carted or shoveled into the hopper and discharged by the elevator upon the shaking screen. The special adaptability of the Robins machinery for this work is due largely to the following facts: All bearings are internally lubricated by grease

and the "Bull's Eye" Sight-Feed Glass P. The sight-feeds are made of a superior grade of glass and are very thick, so that unless broken by some external cause, it is very seldom, if ever, that they break. Should accident happen them, however, the improved arrangement of holding the glass permits of their easy removal. It is only necessary to remove the holder M, after which the retaining ring N can be removed by placing a nail in one of the slots R, and giving a slight tap with a hammer, when it can be easily removed with the fingers.

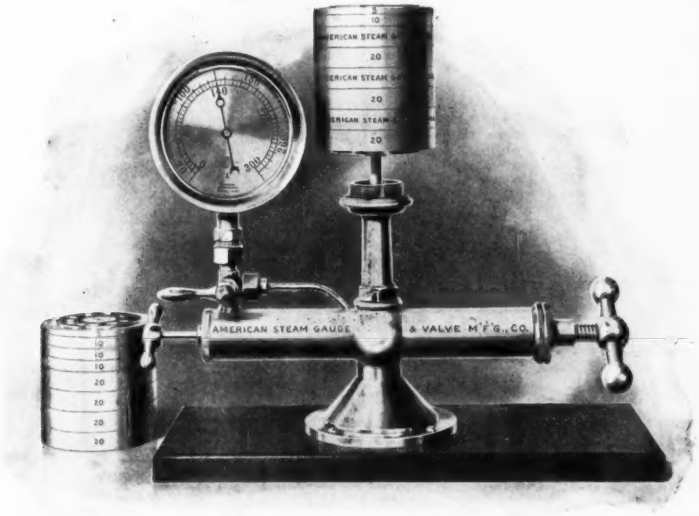
Gauge Tester.

A NEW gauge tester, known as the "American dead weight gauge tester," has been brought out recently by the American Steam Gauge & Valve Co., Boston, Mass. It is asserted that this tester possesses all the advantages of the mercury column enclosed in a much smaller space and supplies a want for a testing apparatus which can be relied upon to be absolutely accurate at all times. It does away with the necessity of returning test gauges to the factory for readjustment from time to time, in order to be assured of their accuracy.

This pump consists of a main pump cylinder B, connected directly with cylinder G and piston F of a known area, operated by weights conforming to the area of the piston.

Cylinder C has a screw plunger for raising piston F under weight.

Auxiliary oil chamber A has a plunger for filling the connection to gauge and main pump cylinder through three way cock D. The oil is contained within the pump at all times, eliminating the necessity of pouring it in and out before and after testing.



NEWS SUPPLEMENT

The Engineering Magazine—August, 1906

Industrial Notes.

—The sixth annual session of the Summer School for Artisans held under the direction of the College of Engineering of the University of Wisconsin, Madison, begins June 25th, and continues for a period of six weeks.

—At a recent meeting of the Regents of the University of Wisconsin, Madison, two important appointments to the faculty were made. Professor W. D. Pence, now head of the department of civil engineering at Purdue University, was elected to the chair of civil engineering, to fill the vacancy caused by the resignation of Professor W. D. Taylor, who has become chief engineer of the Chicago and Alton Railway. Dr. Edward B. Van Vleck, now professor of mathematics at Wesleyan University, was appointed to the professorship of mathematics left vacant by the resignation of Professor C. A. Van Velzer.

—The Canadian Westinghouse Co., Ltd., is supplying the Provincial Light, Heat & Power Co. with apparatus to be used in the development of another large water power plant near Montreal. The initial installation will consist of three 3750 kilowatts, revolving field, alternating current, water wheel driven generators of 4000 volts, three phase, 7200 alternations; also twelve 2500 kilowatts, 44090 volts, oil insulated, water cooled transformers. This new power station will be used for supplying additional power to the Montreal Light, Heat & Power Co. at Montreal. The step-up transformers will be wound for 4000 to 44000 volts, and the lowering from 40000 to 12500 volts. The transmission line is about 40 miles in length.

The American Can Co., Paulsboro, N. J., will install a 20-inch and 42-inch x 42-inch Allis-Chalmers horizontal cross compound engine, direct connected to a 500 kilowatts engine type electrolytic generator and a switchboard, recently purchased from the Allis-Chalmers Co., Milwaukee. The engine will run condensing at 135 steam pressure and 100 revolutions per minute. It will be equipped with a special speed changing device for varying the speed so that the generator voltage may be governed over a range of 100 to 200 volts. The generator will be a 14 pole machine, 500 kilowatts, 200 volts. The shunt field coils will be so proportioned as to allow for increases in voltage between 100 and 200 volts, by approximately equal increments by varying the speed of the engine and by rheostat, the output in amperes being constant at 2,500 throughout the range.

—The Electric Properties Co., incorporated under the laws of the State of New York with a capital of six millions preferred and six million common stock, has been organized to acquire, finance and develop properties, either whole or in part, especially those in which electricity plays the principal part, such as power, electric traction an electric lighting enterprises, and to invest and deal in and to guarantee the securities of corporations operating such properties. It will also conduct through Westinghouse, Church, Kerr & Co. a general engineering and construction business. The purposes of the company will be mainly financial. It is not intended to make any changes in the organization or personnel of Westinghouse, Church, Kerr & Co., whose operations have been highly successful, and they will continue to be conducted under the administration of Walter C. Kerr, president. While the Electric Properties Co. will avail itself of the engineering and construction organization of Westinghouse, Church, Kerr & Co., it will also use other engineering organizations or independent consulting engineers as circumstances may require. One of the objects of the new company will be to co-operate with vested interests, such as railways and other public service companies, in the development of properties for their account, and either temporarily or permanently assist in financing such properties. John F. Wallace has been selected as president of the new corporation, and two vice-presidents will be elected at the first meeting of the Board of Directors.

IMPROVED MACHINERY

New Processes and Appliances

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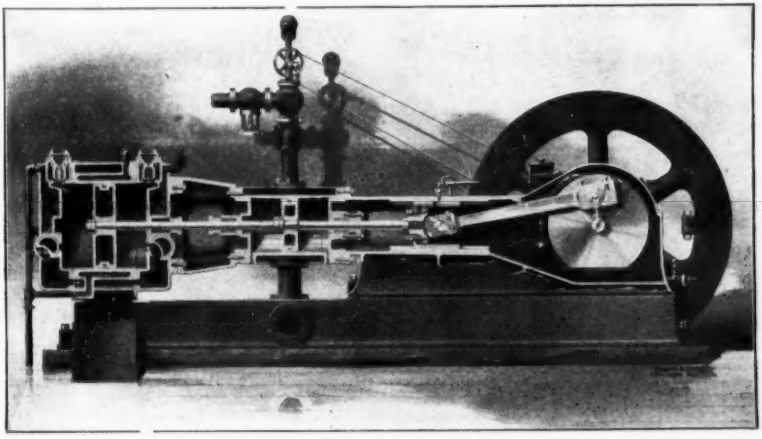
A New Air Compressor.

THE accompanying engraving illustrates a new type of Sullivan air compressor, particularly suited to the requirements of industrial service, in railway and machine shops, foundries and large buildings, as well as to the general purposes of contracting, mining and quarrying work. The machine is of the duplex pattern, and is built in several combinations of steam and air cylinders, also for belt and power drive. The dominant feature of these various types is the box frame, with housing, which forms a tight enclosure about the crank discs, main bearings, eccentrics, connecting rods and crossheads. This housing excludes dust and dirt, and permits the use of a system of self-lubrication of the principal working parts. An oil well is provided in each frame, in which the lower edges of the crank discs are immersed. The oil clinging to the discs is removed by scrapers in contact with their upper edges, and thence conveyed by means of a storage chamber and suitable pipes, to the main journals, crank pins, eccentrics and crosshead guides, being finally returned to the well by gravity to be used again. These machines require the minimum of attention and care, as it is necessary to add oil to wells only at long intervals.



These compressors are very compactly and substantially built. All sizes except those of largest capacity are mounted on a heavy sub-base, in which the intercooler and steam reheater (on cross compound machines) are situated. The frames are of the heavy duty or tangye pattern, with long bearings on the base, securing rigidity, and maintenance of correct alignment of working parts. The steam valve gear is controlled by a Meyer adjustable cut-off, the throttle being regulated by a sensitive steam and air governor. The air cylinders are not cored out, but instead, separate liners are forced into the castings, thus precluding shrinkage strains. The space between the liner and the cylinder forms the water jacket, and outside of this again is the air inlet passage. Incoming air is thus admitted to the cylinder without contact with

heated walls. The air cylinder heads are also water jacketed, and in two stage compressors an efficient intercooler is provided, consisting of a nest of cold water tubes made of copper, with whose cold surfaces the air is forced to come into intimate contact in passing from the low to the high pressure cylinder.

The inlet valves on all air cylinders are of the semi-rotary or Corliss type, and are moved by steel valve stems, connected by adjustable connecting rods to independent eccentrics on the engine shaft. The moving parts start from and arrive at the ends of their travel with a slow and easy motion, but at the points of opening and closing of the valves, these parts attain their greatest speed; it is thus possible for the valves to remain open during the entire stroke, allowing the cylinder to fill with air at barometric pressure, and trapping it instantly before the piston begins its return. The valves themselves are made of close-grained stem-steel, of large diameter, fitted with accuracy. Provision is made to permit a thin film of air to get behind the closed valve, pressing the cutting edges to the seat, and making the valve tight against leakage. The valve stems have T-shaped heads on their inner ends, carefully planed and fitted to the slots in the ends of the valves. The attachment is such that the valves are free to follow up wear automatically without hindrance from the stems. These valves may be removed through the back bonnets without disturbing the setting of the valve gear. This valve gear is simple, strong and durable, is positive and reliable in action, and insures high volumetric efficiency.

The discharge valves are placed radially on top of the cylinder head castings. They are set with removable seats in shallow ports or pockets at a sufficient distance from the ends of the cylinder so that the piston travels completely past the openings to these pockets, at each end of the stroke, thereby reducing clearance to the smallest amount possible. These valves are of the poppet type, internally guided on cast iron plugs and held to their seats by light steel springs. They are seated in bronze cages, readily removable by unscrewing the valve plug. As shown by the sectional view, they are completely surrounded by water jackets, in order to reduce the temperature of the air at its terminal pressure. All working parts are constructed of materials which experience has shown to be best suited for their respective purposes, and all parts of the machine are readily accessible for inspection or repair. These air compressors are built in capacities ranging from 100 to 2,600 cubic feet of free air per minute. The makers, the Sullivan Machinery Co., Chicago, state that they have erected large additions at their works at Claremont, N. H., for the manufacture of this type of compressor.

Fan and Steam Turbine.

THE Wing fan and steam turbine combination is especially adapted for forced draft for boilers and equally available for humidifying of air in factories, and is an ideal exhaust fan for drying goods, removing of steam, dust, foul air, etc.

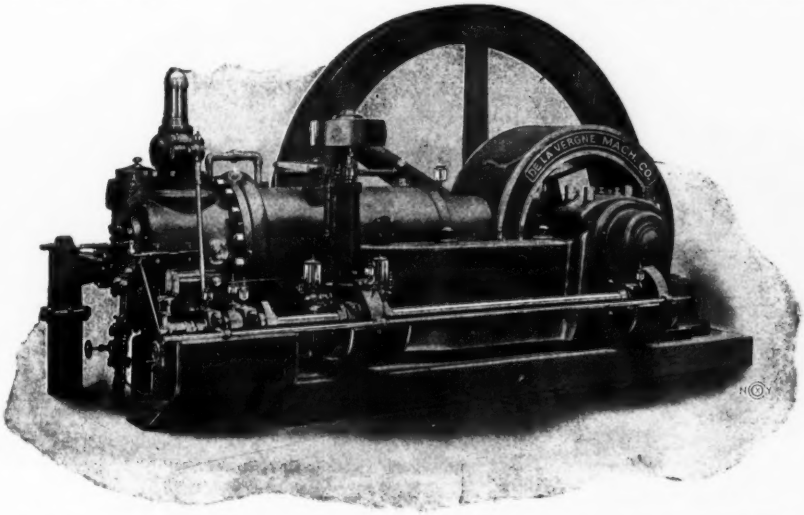
The cost of the fan is moderate, and the expense of running much less than any other fan for exhausting a given quantity of air. It can be erected at any place required, and a very small pipe conveying steam to the turbine completes the equipment. There are no valves to grind, and no care or attention is needed except to fill the oil cup once a week. Made by L. J. Wing Mfg. Co., 136 Liberty Street, New York.

The Koerting Four-Cycle Gas Engine.

THIS engine, made by De La Vergne Machine Co., New York, is of the horizontal four-cycle single acting type, operating as follows: During the first stroke the gas mixture is drawn in; during the second it is compressed; during the third, or working stroke, it is exploded and expanded; and during the fourth the burnt gas is exhausted.

The combustible mixture is formed in the mixing valve, the gas and air openings of which open always in the same proportion. The mixture is therefore always constant and uniform in quality, independent of speed and load. These engines have, on account of this mixing valve, the great advantage of easy and quick starting with automatic and economical operation. The governor operates a balanced butterfly valve between the mixing and the inlet valves,

thereby regulating the quantity of mixture admitted to the cylinder according to load requirements. No charges are missed and therefore the operation of the engine is very uniform under all load conditions. The gas consumption at light load is comparatively very low. Owing to the perfect balance of this valve and the sensitiveness of the governor the regulation of these engines equals that of the best steam engines. This factor renders them desirable for installations requiring the parallel operation of alternating current generators. In order to increase the cooling surface and thereby prevent the danger of pre-ignition caused by high compression, the cylinder cover is provided with a water cooled tongue projecting into the combustion space. Another advantage is the removable cover of the cylinder which allows inspection and cleaning of the valve head and cylinder without removing the piston.

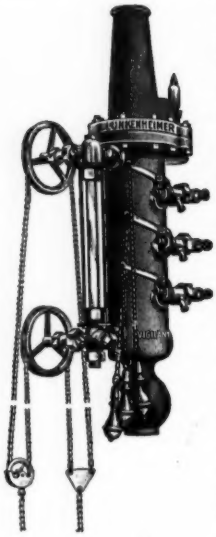


The ignition is effected by electric current generated by an oscillating electro-magneto. The time of ignition can be varied at pleasure, while the engine is running. This feature is of special value when the engine is operated for a considerable time under greatly reduced load. The bed plate, made of cast iron, is heavily built and the cylinder is supported to the end. The outer edge of the bed plate is turned up, forming a slight gutter for the purpose of catching any oil that may run down on the outside of the machine. Ample space is provided in the water jacket to allow any sediment from the cooling water to settle without detracting from the efficiency of the jacket and handholes are provided for removing this. The cylinder is made of special hard close-grained iron. The crank end of the cylinder is packed against the cooling water in the jacket by a small stuffing box which allows free longitudinal expansion. The piston is made of hard and close-grained iron and is of the open-end, trunk type, and connection is made without crosshead and guides. The valve head carries the inlet and exhaust valve, both of which are easily accessible, and are operated by push rods by cams on the lay shaft. The exhaust valve is located a little above the bottom part of the cylinder in order to prevent any oil residuum, which may get into the cylinder, getting into the exhaust valve, which would disturb its proper working. The main bearings are of the ring oiling type. The cylinders are lubricated by a positively driven oiling device, which insures constant and uniform oil supply. The engine is started by means of compressed air.

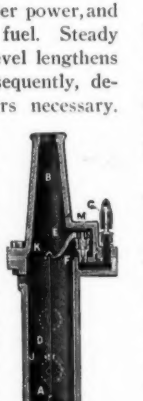
These engines, which run at low speed, are extremely heavy built in units from 75 to 350 H. P., and designed especially for continuous work.

A Safety Water Column.

THE safety water column is so constructed that an alarm is automatically sounded when the water in the boiler approaches the low or high danger limit. The manufacturers claim that they have never had a complaint against the positive action of the column in this respect. It not only safeguards the boiler and its attendants, but from actual tests has demonstrated the fact that a substantial economy in fuel is effected by its use. This is accomplished by carrying the water in the boiler at the lowest constant level consistent with absolute safety, which increases the steam space in the boiler, produces more steam, hence steadier power, and decreases the consumption of fuel. Steady water carried at the proper level lengthens the life of a boiler, and consequently, decreases the amount of repairs necessary.



The manufacturers claim that this improved safety water column will pay for itself many times over in the saving of repair bills alone. They have gauge-cock holes tapped on both sides, consequently they can be used as either right or left hand patterns by transposing the plugs and cocks. If repairs are necessary a cap only need be removed, when all working parts will be exposed and are easily accessible. It is not necessary to take down the entire column or even to remove the water gauge or gauge cocks. But one strong seamless copper float is used, and owing to its form and size, it never fails to operate the signal valve upon the approach of the low or high danger limit. The floats are carefully tested, and will not collapse under 350 pounds pressure. The sediment chamber is a very valuable adjunct to the column, inasmuch as it collects the dirt, scale, etc., that would otherwise enter the water gauge fittings and gauge cocks. A drain can be provided in the bottom of the chamber to discharge the collected sediment.



The columns are made in various sizes suitable for the different types of boilers. The Lunkenheimer Company, Cincinnati, Ohio, are the manufacturers of this improved device, which they have given the trade name "Vigilant."

Wood Block Paving.

F. A. KUMMER read a paper recently at the Chemists' Club, New York, on recent improvements in wood block paving which contains considerable of interest. He said that in the inception of the wood block idea in the East there existed two sources of information and experience upon which the engineer could draw in his efforts to find the best. One of these lay in English and Continental cities where wood block had been successfully laid for years upon streets of the heaviest travel. Engineers and laymen speaking of these pavements, as a rule, referred to three general conditions: first, that the English pavements were better because they were laid on excessively heavy concrete foundations, running in some instances up to 12 inches in depth. It however became apparent that wood pavement required no greater depth of concrete than any other form of pavement, and that this depth in accordance with the practice of most American cities was quite sufficient for the purpose at hand.

The second prominent feature was the use of hard woods from Australia, known as the Karri and Jarrah woods. It was found upon investigation that these woods were by no means used in the majority of instances abroad, that they were laid untreated, were open to the serious objection of the decaying of at least a portion of the blocks, and made a paving surface so hard and slippery that with difficulty horses obtained a foothold on them unless the pavement was frequently sprinkled with sand or crushed stone. On the other hand, the laying of such soft woods as Norway pine, either dipped in creosote oil or treated with about 10 pounds to the cubic foot, did not seem to be a scientific solution of the wood paving problem, and it became evident that better results would be obtained from long leaf yellow pine, which, while harder than the Norway pines, is still not so hard as to be unduly slippery and is susceptible of a complete treatment with preservative material, by which is meant a treatment throughout the entire mass of the block.

The third fact which an investigation of these pavements brought forth was that the blocks were almost universally laid with a joint of from ½ to ¾ of an inch between them. This method of laying was also discarded in investigating the subject, and it was decided to lay long leaf yellow pine blocks thoroughly treated throughout, on a concrete bed of moderate depth, with tight joints.

After securing this information from the foreign practice, the laying of wood block in the western part of the United States, notably at Indianapolis, was looked into, and here it was found while Georgia pine blocks on six inches of concrete, were successfully resisting wear, they had in many instances swelled badly and were almost invariably laid with a heavy pitch expansion joint along the curb to obviate this difficulty. The absorption of water by these blocks was due to two causes: first, insufficient treatment, and second, treatment with ordinary commercial creosote oil. This, it was felt, could be remedied by increasing the amount of treatment from 12 to 14 pounds per cubic foot to 22, and combining with the creosote oil some highly waterproof material, such as melted rosin, to seal up the pores of the wood and prevent both the absorption of moisture and the leeching out of the oil. It was on this basis that wood block pavements in the east were first laid and their success was very great.

We now come to some of the problems which have complicated the question in recent years to such an extent that unless they could be solved, the use of wood pavements could hardly be very extensive. These problems were partly of a commercial and partly of a technical nature. They involved, first, the increasing price and the decreasing quality of the long leaf yellow pine available for the manufacture of paving blocks, and second, the enormous increase, amounting to several hundred per cent, in the cost of rosin. These conditions would result either in the production of a paving block so costly that it could only be used on the most heavily traveled and luxurious streets, or in the production of a block which would be inferior in quality. Neither of these results was in any way desirable and it therefore seemed evident that manufacturers of paving block must find a substitute for long leaf yellow pine to avoid these conditions. The United States Government has also taken a very lively interest in this question and through their suggestions, as well as from other sources, it was concluded that one of the gum woods, existing largely in the south and known as black gum, possessed all the requirements for successful use as a paving material. This wood, on account of the difficulty in preventing it from warping, and other inherent qualities, has been used very slightly for general purposes. It resembles the Australian hard woods above referred to, but while very dense in grain and tough, is not so hard as those woods and not so proof against decay. It was felt, however, that properly treated, it would make a block if anything superior to Georgia pine, and actual tests in service indicate this to be the case.

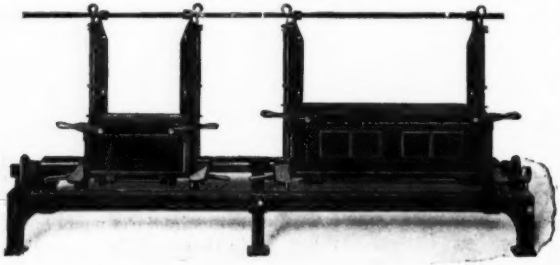
Returning to the question of the treatment, the advance in the price of rosin naturally suggested the use of another material, if another could be found equally as good, or a reduction in the amount used, provided this reduction could be made without decreasing the quality of the product. Great difficulty has been found in obtaining any material which will take the place of rosin as a material for waterproofing and

hardening the blocks. Asphalts and pitches will not mix with creosote oil so that their use is in this way prevented, nor have they the advantage of hardening the fiber of the wood. A thorough investigation of the subject leads to the conclusion that the only way in which the amount of rosin used could be reduced would be by improving the quality of the oil. Creosote oil is generally tested for its gravity and also for its volatizing points. By increasing the gravity of the oil called for and greatly reducing the amounts that evaporate at given temperatures, a far heavier and denser and more permanent oil may be secured and with the use of such an oil, the amount of rosin may be safely cut in half.

These results lead to the very gratifying conclusion that manufacturers of wood block can produce a pavement inferior in no respect to those which have been laid in the past, and if anything, in some respects superior, and which they can safely guarantee under the heaviest travel, without being obliged to ask for such block prices so high as to become prohibitive.

Hercules Cement Stone Machine.

IN the Hercules cement stone machine, shown herewith, the tamping is done on the face, producing stone of many sizes and designs, true to measure and having the appearance of natural cut stone. By tamping on the face a more perfect impression of the design is naturally obtained —a consideration of first importance in the production of good stone, sharp and clean-cut in appearance. The system of tamping on the face, of course, allows the use of two different mixtures—one for facing, and another for the body and back of the stone. This is a highly important feature in the production of artificial stone, as the facing of the block with a richer mixture better adapts it to climatic conditions. The face of such stone does not disintegrate and crumble, which might be the case with a block made with the mixture of about five parts sand on crushed stone to one of Portland cement. The use of an abundance of water, to give perfect chemical action, is of first importance and the system of tamping on the face permits the use of a greater amount of water than can be used with other systems.



The Hercules machine permits the making of two blocks of the same or different sizes on the one machine at the same time, thus saving the expense of an extra machine for doubling the capacity, with very little additional labor-cost.

The face tamping method possesses peculiar advantages for producing stone with a colored face only, thus permitting the manufacture of colored stone at a very slight cost over that of the other.

The Hercules machine is made by the Century Cement Machine Co., 195 West Main Street, Rochester, N. Y.

Mistakes in Waterproofing.

IN a paper read recently before a meeting of the American Society for Testing Materials, Mr. Edward W. De Knight called attention to some mistakes in waterproofing. He maintained that mistakes in waterproofing are the result, mainly, of three causes: faulty design of the thing to be waterproofed; use of improper materials; or imperfect application.

Waterproofing is practically a modern art. Only in recent years has there been any earnest effort to place it on a scientific basis and deduce any system of practice. Old-school methods are as unfitted for present day construction as the bridges of twenty years ago are unfitted for the modern locomotive.

The majority of engineers and architects still follow old-school methods, believe that concrete is waterproof—especially if it be reinforced—and

give no special attention to the importance of design. A faulty design will invalidate the best methods and materials. This is particularly so in bridge work. If the bridge be not properly designed to receive waterproofing, it is almost impossible to make the deck or floor watertight.

It is a mistake to use a set design or specification for general work. Each condition has its characteristics, and should be carefully considered, especially with reference to the nature of the climate, water, soil, rock, water-pressure, use of the structure, etc. A prominent New York architect made the mistake of using on the exterior surfaces of the walls of a 22-story office building, a waterproofing material simply because it had been used fairly successfully on the bottom of a reservoir. His mistake was in the end costly.

In another mistake, the floors in a cold storage building, with a constant temperature near zero, were designed to be waterproofed with materials similar to those used in an ordinary warehouse where the temperature ranged from near zero to 90° F. There had been no thought of making the method and consistency of the products suit the conditions, and the materials used in the cold storage floors turned, in time, almost to powder. In another mistake, an engineer used a reservoir design and method for the foundations of a 12-story office building near tide water. The design being radically inappropriate, the subbasement floor and its waterproofing were broken through when the building was up seven floors. Within twenty-four hours the water was fifteen feet high in the basement. It cost $10,000 to remedy this mistake. In another mistake the design was faulty in improperly grading the surface carrying the waterproofing, which, by missing the outlets by a fraction, allowed sufficient backwater to find its way inside, instead of outside a magnificent granite structure. This mistake will likely cost nearly $40,000. A waterproofing engineer who would have, a glance, noticed the error in the drawings, would certainly in that case have been worthy of his fee.

In another mistake, a wrong design for concrete arch viaduct waterproofing caused the reservoirs to be filled with water which could not escape through weep pipes stopped by cementation. The freezing of the water burst the concrete. After four years it was necessary, to save the viaduct, to waterproof it properly. This mistake was exceedingly costly.

In mill protected property—factories, warehouses, etc.—the losses from water are far greater than the losses directly from the fire. The mistakes in designing floor waterproofing have, in this respect, cost hundreds of thousands of dollars. Yet it is practically a simple thing to design a floor so that it will perfectly retain water to the depth of several inches, and make it independent of and also a protection to every other floor.

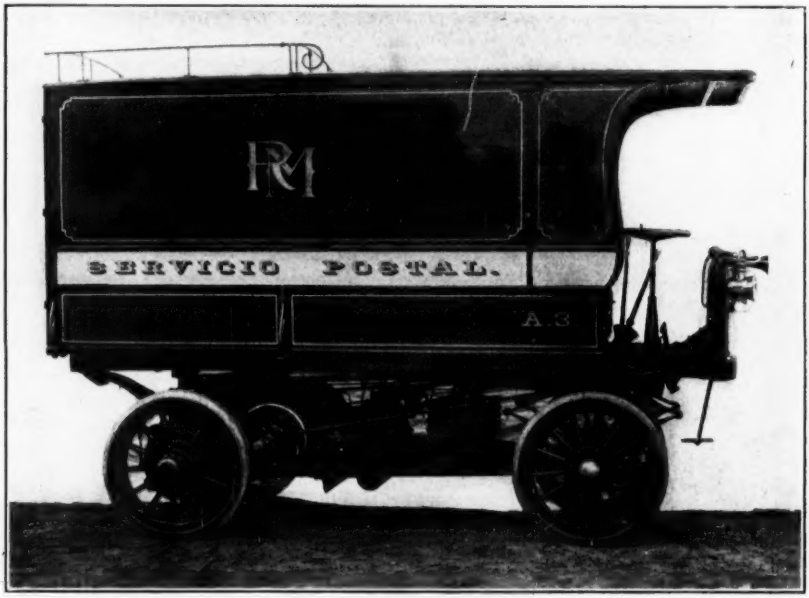
The mistake is in asking, not how much, but how little waterproofing can be used. Contemplate using but four layers of the usual waterproofing materials in work so important, when not fewer than six or eight should be used. Nothing in construction work pays better than good waterproofing. Insufficient, weak, defective waterproofing is a thousand times worse than no waterproofing. The vital work of tunnel waterproofing is, as a rule, done half-way—with insufficient headroom or other provision for properly installing the waterproofing. The usual cause is that tunnel owners, through false economy, fail to make the necessary appropriation. At the end of ten years, they will regret not having doubly provided for and reinforced the entire waterproofing —bottom, sides and top.

Mr. De Knight claims that no material should be used for waterproofing which is not elastic, and that no material should be used for waterproofing which becomes hard or vitreous. It is a mistake, therefore, to attempt to waterproof concrete by hardening the surface, or by using thereon a cement-plaster.

Mr. De Knight's experience in waterproofing has been very extensive and his views, as expressed in his paper, are of great weight. He has prepared copies of his address and will furnish them upon request of those who may be interested in the subject. His address is 120 Liberty Street, New York.

THE Knox Motor Truck Company, Springfield, Mass., have recently shipped to the Government of Mexico for

use in the post office department an Atlas three-ton truck, fitted up with mail wagon body. This is the first one to be put into use by the Mexican Government, and it will be followed by others in the city of Mexico and other large cities of the United States and Mexico. It is estimated by the Government that this postal wagon will do the work of several horse-drawn vehicles and in addition be free from many disadvantages to which horse-drawn vehicles are subjected in that country.



The engine on the truck is a 6x7, developing easily 24 horse power, and is water cooled, which is found to be essential in that country. The gasoline capacity is sufficient to run the truck 200 miles without replenishing, at a speed of twelve to fourteen miles per hour. The carrying capacity is something over 250 cubic feet of mail. The body is highly ornamented in keeping with Mexican ideas.

The auto-truck is becoming a feature in the dispatch of government business as well as in commercial lines, bringing new methods of transportation, and lowering costs of production and distribution. The experimental stage in the manufacture of the motor-truck is passed, and it is taking a prominent place in the development of the modern industrial systems. Such houses as Marshall Field & Co., Montgomery Ward & Co. of Chicago, and the National Biscuit Co., and Standard Oil Co. of New York, use motor-trucks extensively.

NEWS SUPPLEMENT

The Engineering Magazine—September, 1906

Industrial Notes.

—The Lawrence Pump & Engine Co., Lawrence, Mass., designers and builders of the centrifugal pumps, have had plans drawn for an extension to their works.

—The Sprague Electric Co. announces that it has re-opened its San Francisco offices. They are permanently located in the Atlas Bldg., where all orders from that territory will receive attention.

—Two standard economizers are being installed by the B. F. Sturtevant Co., Boston, for the American Steel & Wire Co., Worcester, Mass. These will serve 3,000 boiler horse power.

—The Boston offices of Niles-Bement-Pond Co. and Pratt & Whitney Co. have been removed from Pearl Street to more spacious quarters on the eighth floor of the Oliver Building.

—The U. S. Navy Yard, Indian Head, Md., has just purchased from the B. F. Sturtevant Co., of Boston, Mass., eight of its new style high pressure rotary type blowers, designed for special use.
in stock for prompt shipment.

—The De La Vergne Machine Co., New York, are installing at the E. & G. Brooke Iron Company's plant, Birdsboro, Pa., refrigerating machinery of 350 tons capacity to be used in drying the air blast for their furnaces.

—The National-Acme Mfg. Co., Cleveland, announces that their office formerly located at 176 Federal St., Boston, has been transferred to 95 Liberty St., New York, and that M. M. Brunner will continue in charge.

—The Lawrence Pump & Engine Co., Lawrence, Mass., manufacturers of the centrifugal pumps, have appointed Chas. F. Chase as their selling agent for the Middle States, with offices at 39 Cortlandt St., New York, and The Bourse, Philadelphia.

—The Weston Electrical Instrument Co., Newark, have taken Caxton Brown into the Newark factory as secretary and sales manager, and have put Stanley Brown in his place as manager of the New York office.

—The Pelton Water Wheel Co. has completed its new works located at 19th and Harrison Sts., San Francisco. These shops were under construction before the fire and will afford the most modern facilities for handling and turning out high grade work.

—Risdon Iron Works, San Francisco, report the receipt of an order from the Utah Copper Co. for 80 concentrators of the Johnston type. They have also received an order from the Boston Consolidated Mining Co. for 234 machines.

—Mechanical draft is to be installed by the B. F. Sturtevant Co., Boston, in place of chimneys, for Crane & Breed Mfg. Co., Cincinnati; A. N. Pierson, Cromwell, Conn.; Rosemary Mfg. Co., Roanoke Rapids, N. C.; Chesseman Chemical Co., Scranton; Hampton Co., East Hampton, Mass.

—The new office building in process of erection in connection with the mammoth plant of Wood Worsted Mills, South Lawrence, Mass., is to be equipped throughout with a blower heating system, the apparatus for which, consisting of an engine driven fan and heater, is to be furnished by the B. F. Sturtevant Co., of Boston.

—The Crocker-Wheeler Co. have now completed arrangements and have opened an office and warehouse at 208 First Street, San Francisco, with H. C. Baker as local manager. They have also opened an office at 447 Pacific Electric Bldg., Los Angeles, with L. Cummins as representative, and are arranging to establish an office in Seattle in the near future.

—The Abner Doble Co. announces that it has relocated its offices at its former site, Fremont and Howard Streets, San Francisco. Work is progressing rapidly on the company's new shops and warehouses in the Potrero district at Seventh and Hubbell Streets. Temporary pattern and forge shops are already in operation on the new site.

—The Platt Iron Works Co., which has long had offices on Liberty Street, New York, has been forced by the growth of its business to take larger office quarters at 100 Broadway. A large wareroom with a complete line of all patterns of pumps and compressors, feed water heaters, condensing apparatus, etc., has also been established at 81 West Street, where repairs are carried

—On account of the difficulty in obtaining brass and bronze castings suitable to its high pressure hydraulic work, the Watson-Stillman Co. has determined to build its own foundry, which will be equipped with special appliances for making high grade castings, suitable for hydraulic work. The design has been entrusted to G. K. Hooper, New York, who designed their plant at Aldene, N. J.

—The Cincinnati branch office of the B. F. Sturtevant Co. has just been moved into much larger quarters at 329 West 3rd St., where a complete stock of blowers, engines, forges, exhaust heads, etc., will be carried. Many of the products of this company, such as heating, drying, ventilating and mechanical draft apparatus, economizers, electric fans, are manufactured on specifications to meet exact requirements. The office is under the management of E. Worthing.

—The growing popularity of plunger elevators over the older types has given rise to a demand for special machines for boring the holes into which the plunger sinks. This is especially the case where plunger elevators are used in tall office buildings and for this service the Star Drilling Machine Co., Akron, O., is manufacturing a special machine known as "No. 25 Elevator Machine." They report that thirty-one of these special outfits have recently been sold.

—The De La Vergne Machine Co., New York, reports the following recent orders for "Hornsby-Akroyd" oil engines: Wheaton Seminary, Norton, Mass., 13 h.-p.; P. R. Mfg. Co., Detroit, 50 h.-p.; Rahr Brewing Co., Oshkosh, 32 h.-p.; The Vitagraph Co., Brooklyn, 25 h.-p.; Regal Oil & Gas Co., Chicago, 65 h.-p.; L. R. Wright, Pecos, Tex., 13 h.-p.; Jas. H. Holden, Fall River, 75 h.-p.; Borough of Souderton, Souderton, Pa., 50 h.-p.; James L. Breeze, Southampton, L. I., 35 h.-p.

—The following are a list of six recent sales by the Crocker-Wheeler Co., Ampere, N. J.: Allentown Spinning Co., one 60 KW DC engine type generator, 125 volts, 675 RPM. Northern Coal & Coke Co., one 80 KW DC generator, 250 volts. N. J. Zinc Co., four motors ranging from 10 to 35 H. P. Haverford College, one 125 KVA, engine type AC generator 2300 volt 60 cycle, 3 phase, 257 RPM. Mohawk Valley Cap Co., one 300 KW DC generator, 480 volt, 150 RPM, one 18 KW DC generator, 125 volts, 175 RPM, and two motors ranging in HP from 10 to 75, all of 440 volts. E. I. DuPont Co., one 130 KW DC generator, 550 volts.

—One of the original fan system heating and ventilating plants installed by the Buffalo Forge Co. in Buffalo was placed in the first works built by the Geo. N. Pierce Co. This outfit was built a quarter of a century ago, and was used in the factory in which the Pierce bicycles have been built. The Pierce buildings have long been overcrowded, and since the fire, which destroyed a part of the Hanover St. plant last winter, plans have been drawn up and contracts let for a magnificent group of buildings located on the Pan American site. The entire contract for heating and ventilating all of the buildings in the new Elmwood Ave. plant has been awarded to the Buffalo Forge Co.

—On July 30th last a boiler exploded at the mill of the Vincennes Paper Co., Vincennes, Ind., killing two men and wrecking part of the boiler house. Four days later, August 3d, full payment for damages was made by the Casualty Company of America, which had insured the boilers. While this is believed to be the record for quick settlements, this company makes a practice of settling all such claims as quickly as possible in the interest of the assured. During the first six months of the present year the boiler insurance written by the Casualty Company of America was more than ninety per cent greater than that written for during the corresponding period in 1905. Recent insurance placed by them covers all the steam boilers of the Republic Steel Company and the Tennessee Coal & Iron Company—several hundred boilers in many different states.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Air Washer and Humidifier.

BUFFALO FORGE CO., Buffalo.—Catalogue No. 97 illustrating and describing the Buffalo air washer and humidifier. 6 by 9 in.; pp. 36.

Ball Bearings.

STANDARD ROLLER BEARING CO., Philadelphia.—Catalogue No. 12 contains illustrations, descriptions and price lists of over 50 different types of ball and roller bearings. 4½ by 7 in.; pp. 110. Catalogue No. 16 illustrates and describes ball bearings for automobiles. 7 by 10 in.; pp.80.

Chains.

BALDWIN CHAIN AND MANUFACTURING CO., Worcester.—Catalogue No. 6 is devoted to an illustrated description of a detachable chain. 5½ by 7½ in.; pp. 24.

Coal Mining Machinery.

SULLIVAN MACHINERY CO., Chicago.—Catalogue No. 57, entitled "Modern Methods of Producing Coal," illustrates and describes a new coal pick machine. 6 by 9 in.; pp. 56.

Die Stocks.

HART MANUFACTURING CO., CLEVELAND.—Pamphlet containing an illustrated description of duplex die stocks and thread cutting tools, together with tables giving prices and weights. 4 by 6 in.; pp. 40.

Drills.

FOOTE, BURT & CO., Cleveland.—Catalogue containing an illustrated description of multiple spindle drills. 5 by 7½ in.; pp. 70. Also a catalogue treating of bolt threading, pipe threading and nut tapping machinery and accessories. 6 by 9 in.; pp. 56.

CLEVELAND TWIST DRILL CO., Cleveland.—Catalogue giving the sizes and prices of twist drills, reamers, taps, mill cutters, etc. Illustrated. 6 by 9 in.; pp. 18. Also a pamphlet containing an illustrated description of tools for turret lathes and screw machines. 6 by 9 in.; pp. 16.

Electric Motors and Trailer Trucks.

AMERICAN LOCOMOTIVE CO., New York.—Catalogue illustrating and describing several types of trucks adapted to the requirements of the heavier electric service of the present, including motor trucks for electric locomotives and electric motor cars, also trailer cars. 9 by 6 in.; pp. 58. Also a pamphlet giving the results of locomotive tests made by the Pennsylvania R. R. 9 by 6 in.; pp. 56.

Electrical Equipment.

GENERAL ELECTRIC CO., Schenectady.—Bulletins Nos. 4441, 2, 4, 5, and 8 illustrating and describing subway transformers, railway motors, motor driven air compressors, Curtis steam turbine generators, and small polyphase motors respectively.

Elevating and Conveying Machinery.

WEBSTER MANUFACTURING CO., Chicago.—Catalogue and price list No. 30 illustrates and describes elevating and conveying machinery for handling all kinds of material. Power transmission machinery for the transmission of power by rope, shafting, pulleys, etc., and coal handling machinery are also treated. The catalogue is well printed and is bound in cloth. 6 by 9 in.; pp. 574.

Feed-Water Heaters.

WARREN WEBSTER & CO., Camden, N. J.—Catalogue illustrating and describing feed-water heaters and purifiers for capacities ranging from 500 to 5,000 horse-power. 6 by 9 in.; pp. 32. Also a pamphlet containing a reprint of an article that appeared in the *Street Railway Journal* entitled "Some Phases of the Feed-water Heater Problem," by Walter E. Harrington.

Forging Machines.

AJAX MANUFACTURING CO., Cleveland.—Cloth bound catalogue, printed in two colors, illustrating and describing forging, heading and upsetting machinery. 8½ by 5½ in.; pp. 74.

Gas Engines.

DE LA VERGNE MACHINE CO., New York.—Folder illustrating and describing the Koerting four cycle gas engine and suction producer. 4 by 9 in.; pp. 10.

Grinders.

LANDIS TOOL CO., Waynesboro, Pa.—"Landis Grinders; How to Use Them" is the title of a well-printed catalogue illustrating and describing grinders. 6 by 9 in.; pp. 76.

CINCINNATI MILLING MACHINE CO., Cincinnati.—Catalogue containing a treatise on tool room grinding and grinding machines. 6 by 9 in.; pp. 92. Also a pamphlet showing examples of rapid milling. 6 by 9 in.; pp. 52. Both publications are well printed and illustrated.

Machine Tools.

AMERICAN TOOL WORKS CO., Cincinnati.—Sectional catalogue illustrating and describing lathes, planers, drills, shapers, etc. 8¾ by 11 in.

Metal Working Machinery.

BEAMAN & SMITH CO., Providence.—Catalogue F illustrating and describing metal working machinery, especially milling and boring machines. Also contains a table giving cutting speeds. 6 by 9 in.; pp. 122.

Motors.

CROCKER-WHEELER CO., Ampere, N. J.—Bulletin No. 67 illustrates and describes variable speed motors for use in the machine shop.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., Pittsburg.—Circular No. 1129 illustrates and describes Westinghouse No. 119 rail-

way motors for direct-current service. 7 by 10 in.; pp. 16. Circular No. 1134 treats of electrical and mechanical brakes for Westinghouse type K motors. 7 by 10 in.; pp. 12.

Motors.

NORTHERN ELECTRICAL MANUFACTURING CO., Madison, Wis.—Bulletin No. 53 treats of single voltage variable speed systems for machine and machine tool drives. Illustrated with views of machines showing the motor attached. 7 by 10 in.; pp. 36.

Plantation Machinery.

GEO. L. SQUIER MANUFACTURING CO., Buffalo.—Booklet illustrating and describing plantation machinery, including sugar mills, centrifugals, engines, boilers, coffee machinery, etc. Also a catalogue dealing with rice machinery. pp. 16.

Pneumatic Tools.

DAYTON PNEUMATIC TOOL CO., Dayton.—Large post card illustrating and describing the Green pneumatic hammers.

GENERAL PNEUMATIC TOOL CO., Montour Falls, N. Y.—A series of bulletins illustrating and describing pneumatic tools, compression riveters, air compressors, electric hoists and pneumatic hoists.

CHICAGO PNEUMATIC TOOL CO., Chicago.—Circular No. 56 is devoted to an illustrated description of air cooled electric drills, portable grinders, blowers and drilling stands. Also Catalogue No. 19 illustrating and describing pneumatic stone tools, together with views showing the tools in operation. 6 by 9 in.; pp. 48.

Punching and Shearing Machinery.

CLEVELAND PUNCH & SHEAR WORKS CO., Cleveland.—A handsome loose-leaf catalogue, with a flexible leather cover, briefly describing punching and shearing machinery. The catalogue is illustrated with original photographs. 12¼ by 9¼ in.; pp. 94.

Recording Instruments.

BRISTOL CO., Waterbury, Conn.—Bulletin No. 41 containing a brief illustrated description of the many different types of recording instruments. 3 by 6 in.; pp. 12.

Rock Drills.

INGERSOLL-RAND CO., New York.—Catalogue No. 383 illustrates and describes the Temple-Ingersoll electric-air rock drill for mining, tunneling, quarrying and general rock excavation. 6 by 9 in.; pp. 40. Bulletin No. 2007 treats of "Imperial" piston drills, together with tables giving dimensions. 6 by 9 in.; pp. 36.

Rotary Engines.

OSTRANDER STEAM ROTARY ENGINE CO., Yonkers, N. Y.—Small pamphlet illustrating and describing multiple expansion rotary engines. 3½ by 6 in.; pp. 8.

Separators.

DIRECT SEPARATOR CO., Syracuse.—A neat little booklet containing an illustrated description of Sweet's separator. Also contains tables giving dimensions, weights, etc. 3½ by 6 in.; pp. 12.

Steam Engines.

LANE & BODLEY CO., Cincinnati.—Catalogue illustrating and describing heavy duty Corliss engines. 9 by 6 in.; pp. 26.

ATLAS ENGINE WORKS, Indianapolis.—Bulletin No. 131 contains an illustrated description of single valve engines. 8 by 10½ in.; pp. 16.

NAGLE ENGINE AND BOILER WORKS, Erie, Pa.—Catalogue No. 43 contains a description of the Nagle-Corliss engine. Catalogue No. 48 treats of their horizontal stationary tubular boilers. 9 by 6 in.; pp. 28.

ALLIS-CHALMERS CO., Milwaukee.—Bulletin No. 1505 treating of heavy duty steam engines, belted type. Illustrated. 8 by 10½ in.; pp. 20. Bulletin No. 1051 illustrates and describes alternating current generators, belted type. 8 by 10½ in.; pp. 16.

Steam Traps.

THE GREENWAY CO., Detroit.—A well-printed pamphlet entitled "The Remedy for Steam Trap Troubles," containing an illustrated description of steam traps. 3 by 8 in.; pp. 12.

Tanks.

G. M. DAVIS & SON, Palatka, Fla.—Catalogue No. 6 illustrating and describing cypress tanks, tubs, etc. Also contains much information of a valuable nature. 6 by 9 in.; pp. 24.

Tapping Machines.

BAKER BROS., Toledo.—Catalogue No. 4B illustrating and describing tapping, boring and drilling machines. 6 by 9 in.; pp. 36. Catalogue No. 5 is devoted to an illustrated description of the Colburn universal saw bench with attachments. 6 by 9 in.; pp. 24. Catalogue No. 8 treats of the Colburn key-seater and slotter. 6 by 9 in.; pp. 72.

Time Checks.

AMERICAN RAILWAY SUPPLY CO., New York.—Pamphlet entitled "Time Checks and Their Use" describes the many uses to which these checks may be adapted. Illustrated. 3 by 6 in.; pp. 8.

Tumbling Barrels.

BAIRD MACHINE CO., Oakville, Conn.—Catalogue C illustrating and describing tilting tumbling barrels. 6 by 9 in.; pp. 16.

Water Wheel Governors.

LOMBARD GOVERNOR CO., Ashland. Mass.—Bulletin No. 106 is devoted to an illustrated description of type Q governors. Illustrated. 7 by 10 in.; pp. 4.

LUDLOW VALVE MANUFACTURING CO., Troy.—Catalogue, issued by the Sturgess Engineering Department, illustrating and describing vertical type water wheel governors, together with many views showing recent installations. 8 by 10 in.; pp. 62.

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Lidgerwood Erection and Pile Driving Engine.

Over 26,000 in use.

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FOR ALL HOISTING PURPOSES

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Voltmeters, Ammeters, Ohmmeters, and Circuit Testers.

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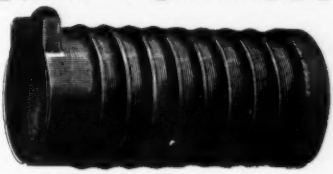

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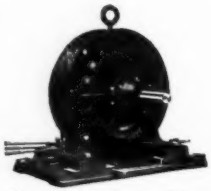
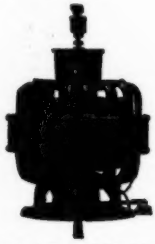


Type CCL Induction Motor

Back Geared Type CCL Motor



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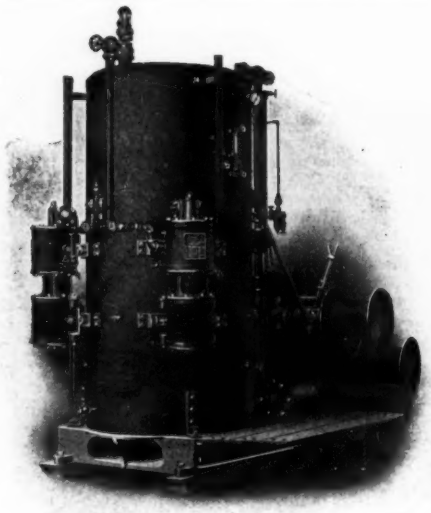

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Air Compressors

The illustration shows manner of attaching compressors to boiler of a hoisting engine. A convenient and space-saving arrangement for supplying air for pneumatic tools, sand blast, paint spraying, etc., in the erection of steel structures; also for railway contractors in tunnel and other work requiring compressed air.

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Mex. City, Mex. 4½ Calle de San Diego.
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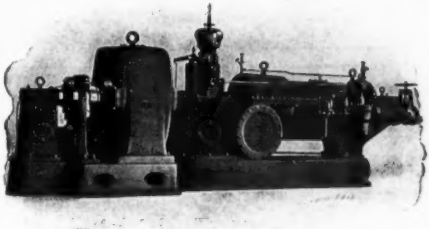

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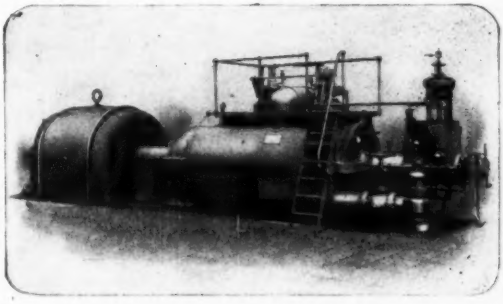

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More than **70** center-pier swing bridges have already been **superseded, discarded, scrapped,** and **replaced** by **modern SCHERZER ROLLING LIFT BRIDGES** for **Railroads, Electric Railways** and **Highways** in the United States and abroad.

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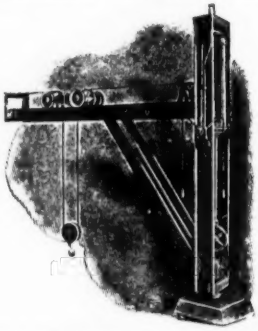

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Please mention The Engineering Magazine when you write.

THE PASSING OF TIN

FOR many years practical men have been familiar with the fact that the quality of Tin Plates has been rapidly deteriorating.

For roofing purposes, where the test is most severe, the use of tin has been growing less and less. Owners complain that *constant painting and repairing* are necessary to insure even a *moderately* tight roof.

The continued dissatisfaction of the Tin Roofers finally resulted in a conference with the Tin Plate manufacturers with a view of devising some means of improving the grade of Tin Plate and getting back some of the lost business. The report of the conference brought out very strongly the fact that Tin roofs are not giving general satisfaction, and verifies absolutely our contention that *Barrett Specification Roofs* are more economical and satisfactory in every way.

We quote a few opinions expressed at this convention by some of the leading Tin Roofers in attendance, as published in "The Metal Worker" Feb. 24, 1906.

OTTO GOEBEL: "The roof on a building covered seven months ago with one of the best known high-grade plates gave way and now a slag roof protects the building."

W. H. BARNARD: "I was so patriotic that I was eager to put on the first American tin roof in Norfolk and wanted to paint it red, white and blue, but am glad that I didn't for that roof came off long ago and other material protects that building from the weather."

O. H. A. MILHAN: "In 1888 I put the roofs on a new row of twenty-seven houses, using 14x20 tin that I paid $4.90 a box for. In 1895 I put American tin plate on fourteen houses across the street, and, as I was asked to put on a better roof, I paid $9.75 a box for the tin. *In 1900 I covered the American tin with a slag roof.* Recently I repaired the old tin roofs and they are in good condition. Three years ago an old-method plate was put on a roof by the use of 10x14 plate and now there are from one to fifty pinholes in every sheet."

S. HARRIS: "I put on a roof a year ago, using guaranteed plate. The supply house is replacing part of it now."

G. W. BUTLER: "I put on tin roofs in 1868 that are in use yet. I used American tin plate for myself because I wanted a good job, but in two years it pinholed, and if there had been a demand for a perforated plate I could have sold it."

A. KOHLHEPP: "We used to get a plate that on exposure showed a blue copper color, and it stood well. The plate we get now will not stand over four years."

E. GICHNER: "An old German employer of mine said, twenty years ago, 'tin plate was bad, fifteen years ago worse, ten years ago worser, and five years ago the worsest yet.'"

E. L. FLOUNDERS: "It is not the coating of the plates, but the plates. I soldered gutter seams, so that I know the plate was protected by a heavy coat of solder, yet I could lift solder for two inches from a rust eaten plate."

Wm. MARTIN: "In Baltimore city ninety per cent of the roofs that are being put on are of some other material than tin."

We will send on request the Barrett Hand Book describing in detail the *Barrett Specification Roof* of Coal Tar Pitch, Felt and Slag or Gravel. Many such roofs have lasted over thirty years, without attention or repairs. They cost less than tin and are guaranteed for at least ten years.

Barrett Manufacturing Company

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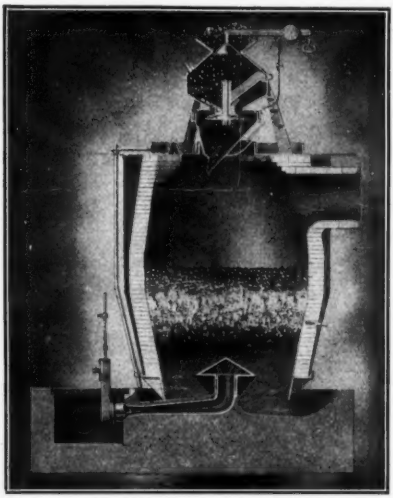
GAS PRODUCERS

Most of the leading makes of Gas Producers are in operation at the plant of the Lackawanna Steel Co Buffalo, N. Y Of all these, the only make whose merits have resulted in a second order is that of the



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Construction Company

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The Morgan Continuous Gas Producer often saves from 25% to 50% of the labor and fuel consumed in direct coal firing for heating, burning and melting operations in furnace or kilns.

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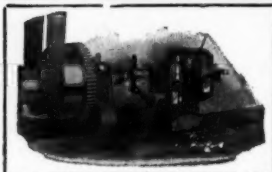

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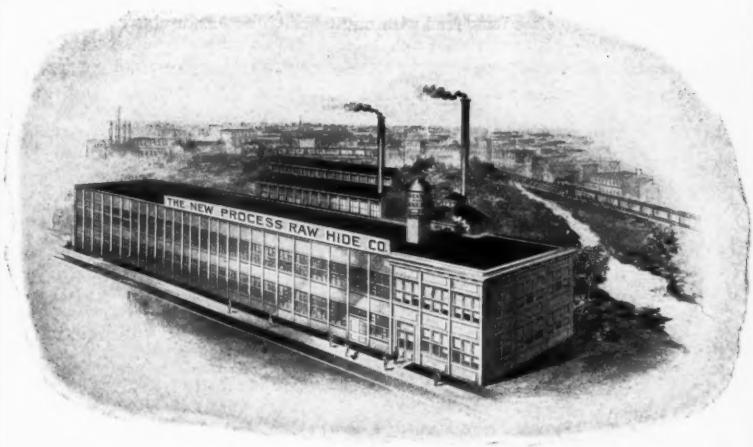

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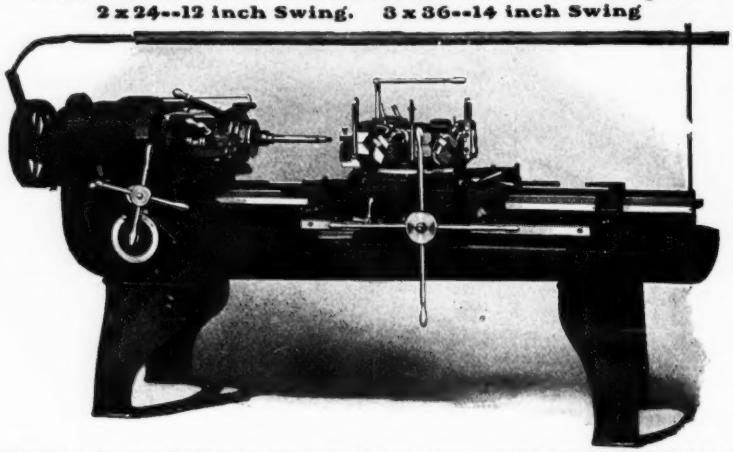

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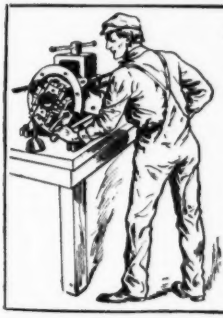

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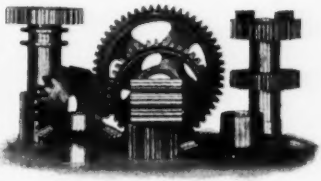

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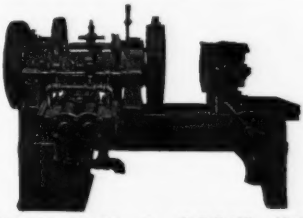

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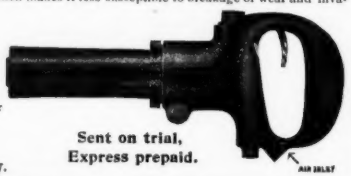

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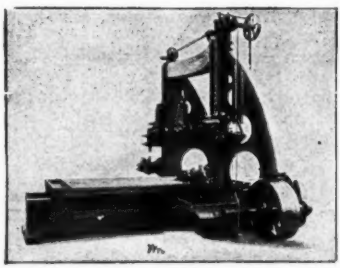

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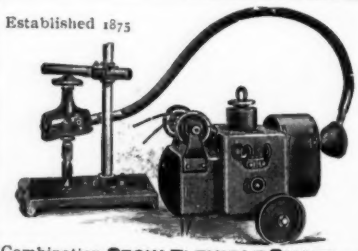

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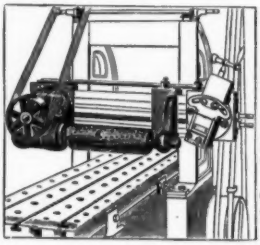

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With it milling, boring and planing can be done on a casting at one setting.

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The Adams Co.
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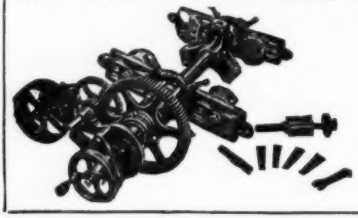

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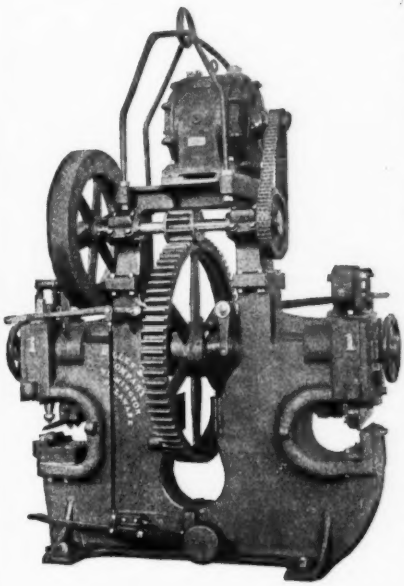

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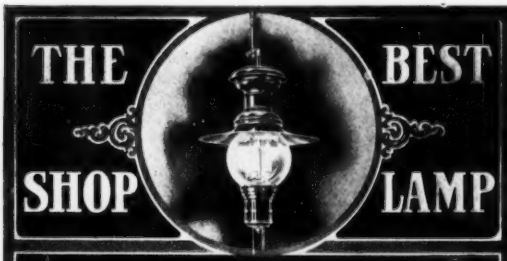

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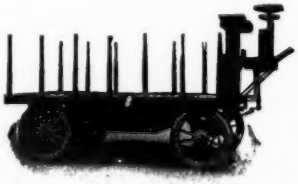

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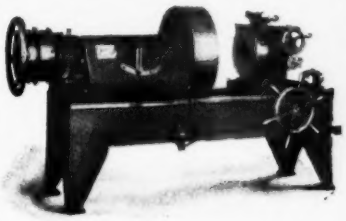

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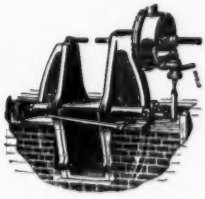

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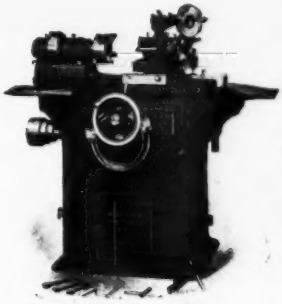

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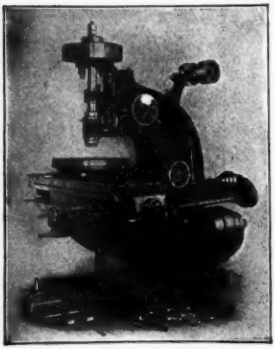

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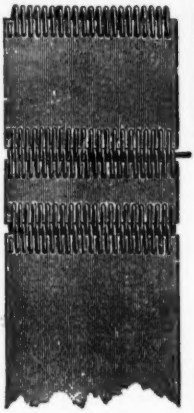

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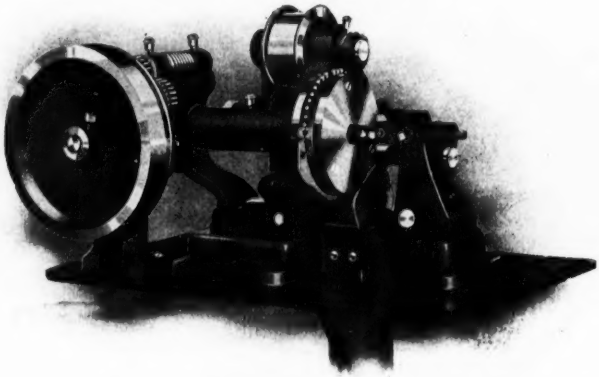

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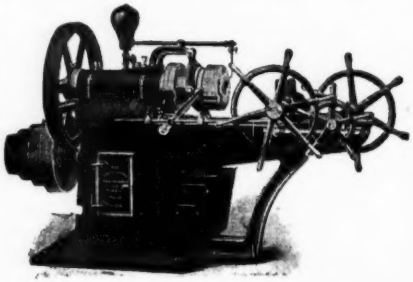

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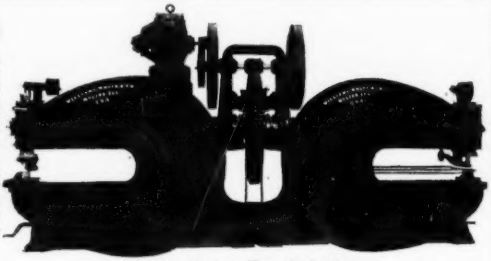

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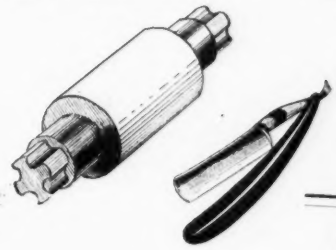

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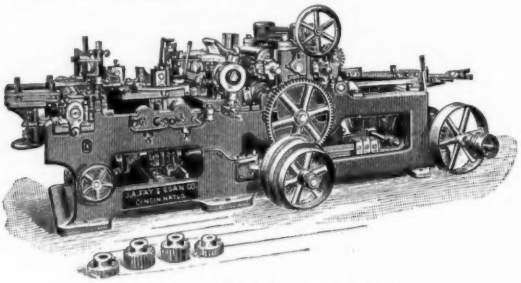

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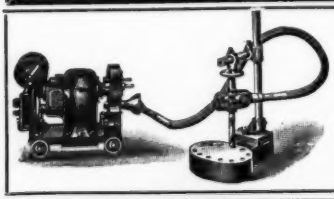

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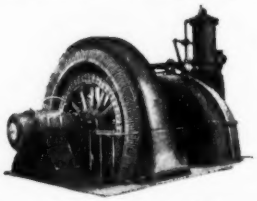

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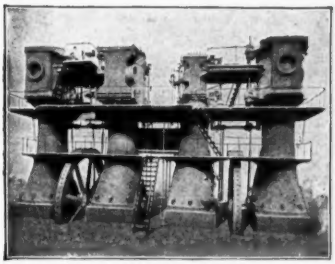

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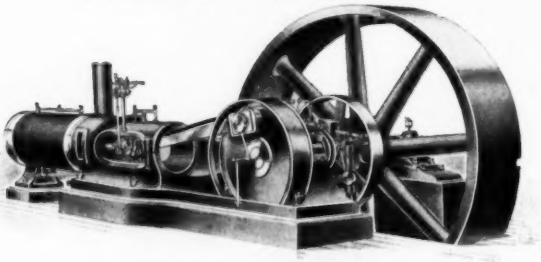

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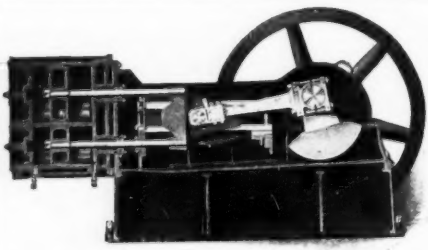

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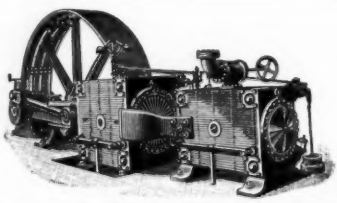

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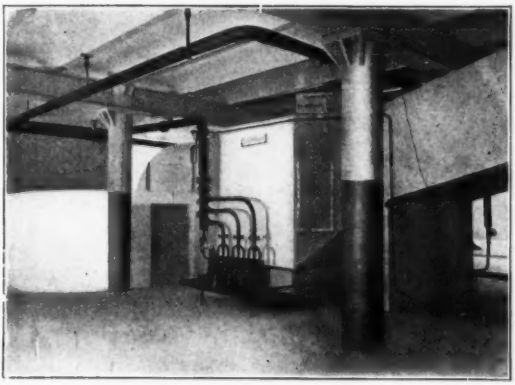

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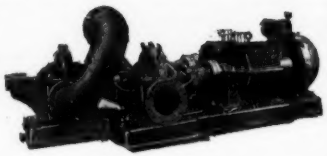

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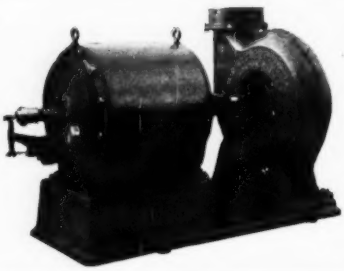

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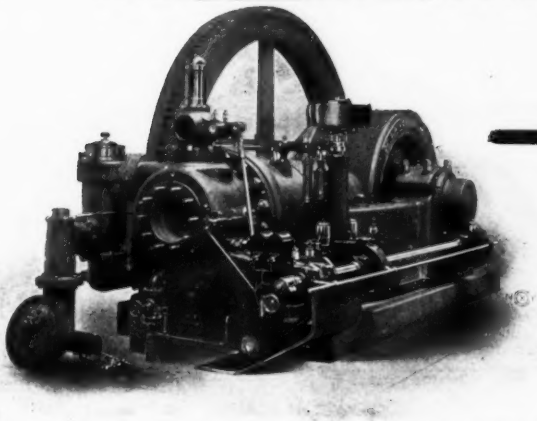

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Cylinder Head on Floor in Front Shows Cooling Tube.

Without sufficient cooling preignitions are frequent. The Koerting gas engine in addition to the ordinary jacket is provided with a cooling tube which projects into the cylinder. This feature does away with preignition and enables the engine to operate with high compression.

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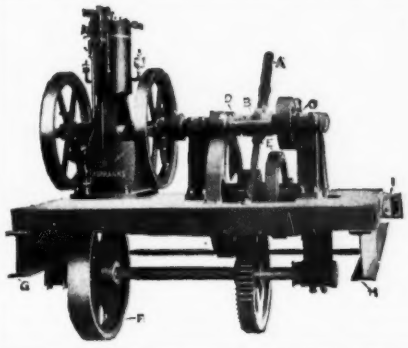

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use manufactured, natural or producer gas, gasolene, alcohol or distillate as fuel; there are six distinct types, ranging from 1 to 100 H. P., including stationary, portable and marine, of both two and four cycle. We send experts to make direct connections of these engines to pumps, compressors, generators, hoists, etc. We are also headquarters for Scales, Trucks, Transmission, Valves, Railroad, Factory and Mill Supplies, Machine Tools, etc. *Write us for Catalogue.*

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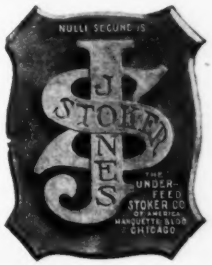

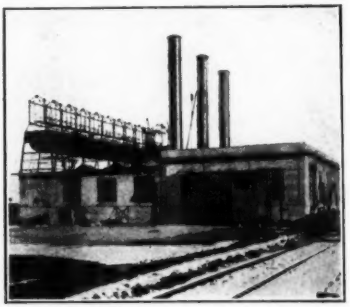

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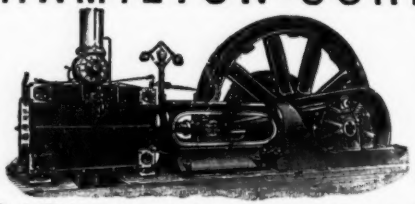

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Takes the Place of Illuminating Gas or Gasoline
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Burns Less Coal

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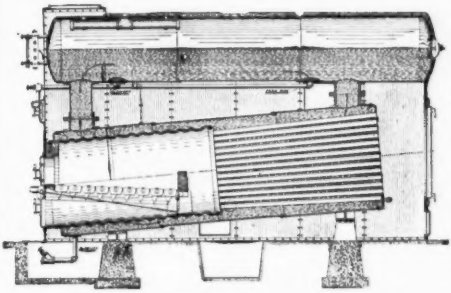

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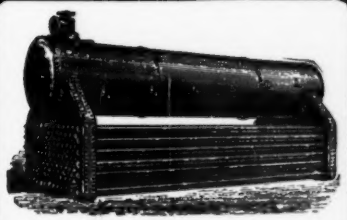

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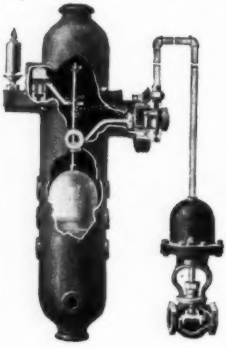

For years the automatic control of feedwater to boilers was considered impossible and impracticable,

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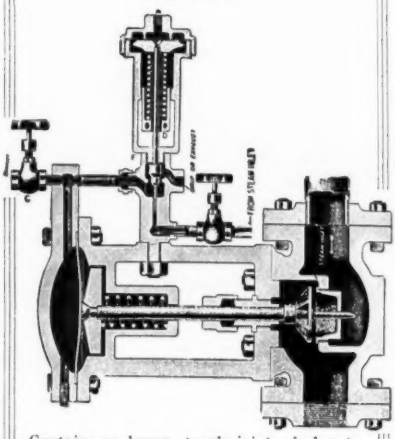

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The pressure may be reduced from 175 pounds to ½ pound in *one reduction*.

The valve contains a by-pass within itself and therefore does not have to be installed in a by-pass, which only adds expense and complication to the fittings.

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The main diaphragm is far from the feed valve and its chamber is always water-sealed. It works perfectly with *superheated steam* and may be placed on the hottest part of the boiler as there are no exposed parts. The pilot valve makes the arrangement sensitive; the main diaphragm and valve make it sure and long lived.

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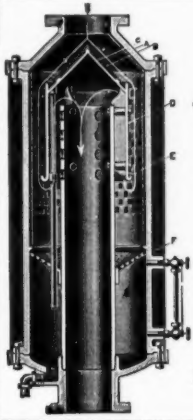

deliver live steam 99½% dry and remove 99% of oil in exhaust steam. Are made in all styles and sizes and guaranteed in every way.

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is *the only one* that will take care of a large influx of water, positively separate it from the steam, and keep it separated, and so long as the drain pipe is open no water will be again picked up and carried to the engine. That involves considerably larger proportions and higher first cost. But it is a wise investment — you get your money back over and over again.

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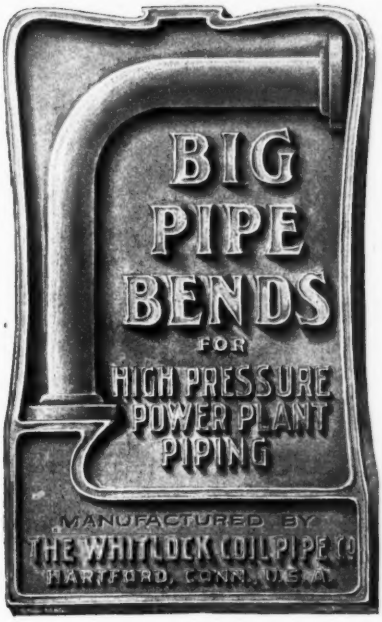

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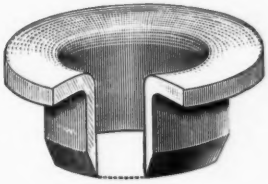

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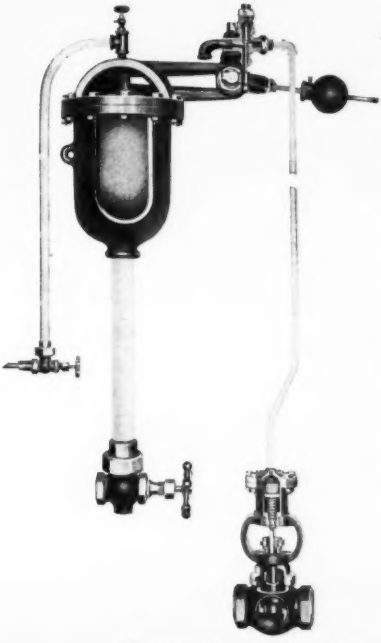

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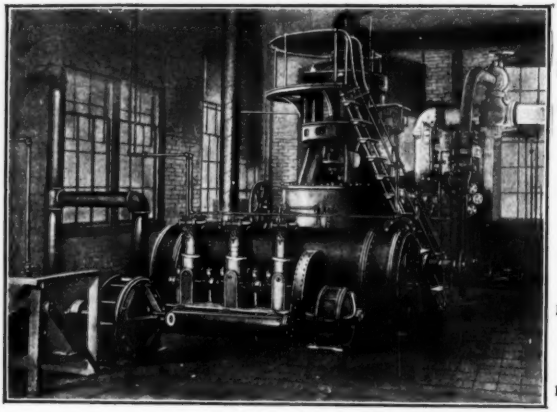

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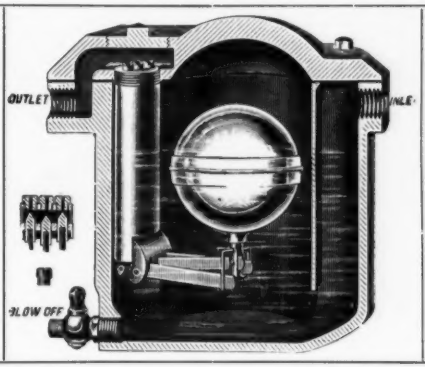

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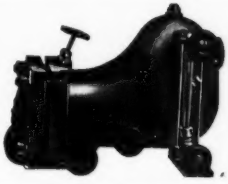

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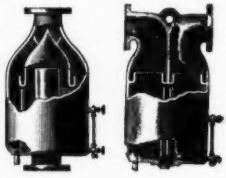

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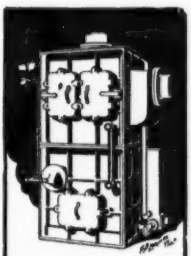

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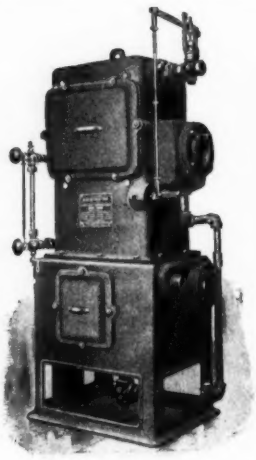
Please send us information regarding how you go about it to make the particular improvements we have indicated above.

Our boiler plant is about.....H. P.
We have.....H. P. of exhaust steam available.

Name..... .... Address.....



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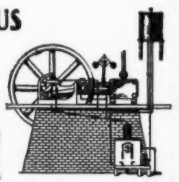

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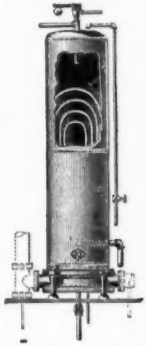

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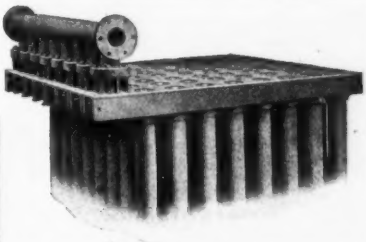

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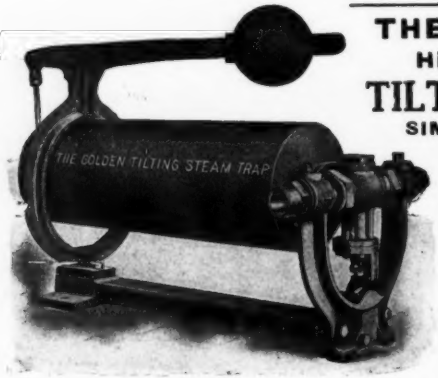

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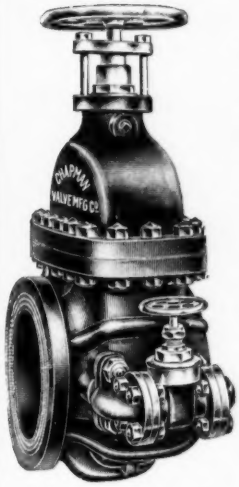

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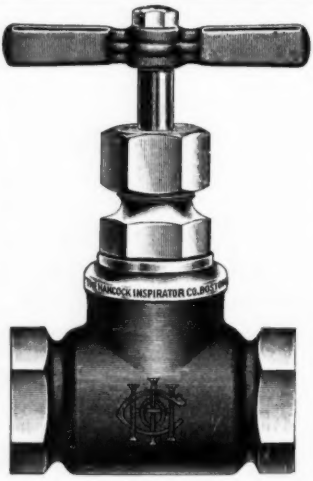

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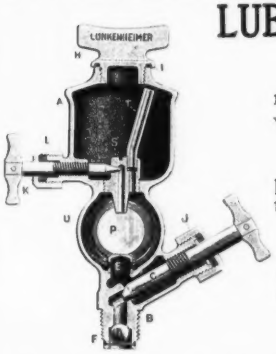

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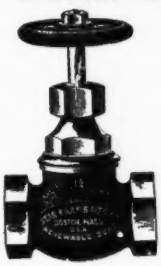

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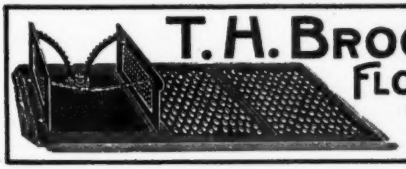

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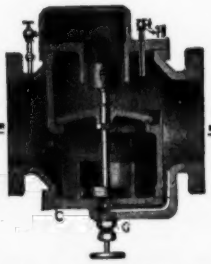

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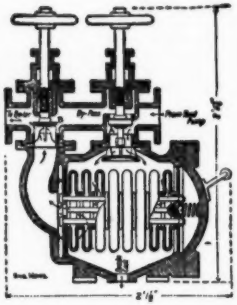

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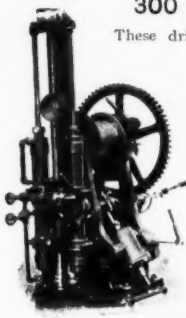

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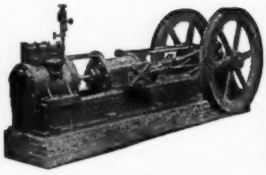

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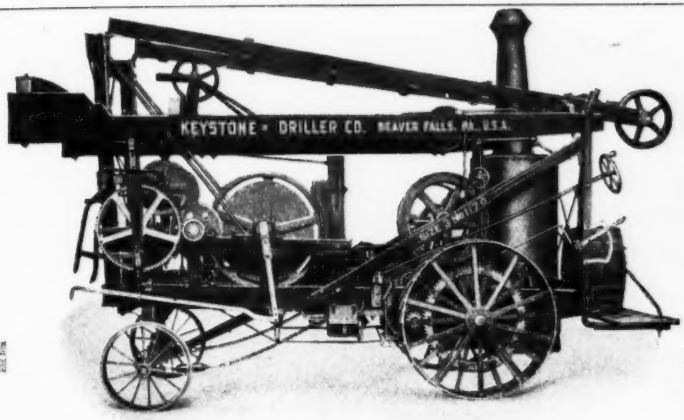

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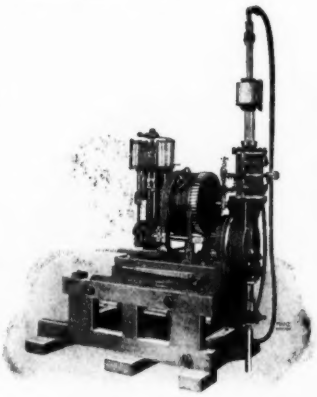

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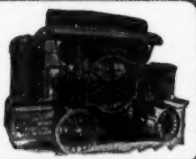

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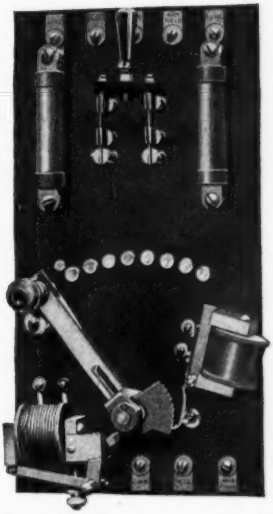

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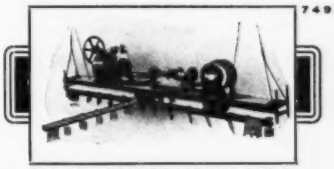

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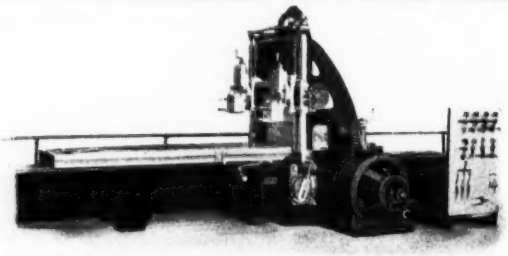

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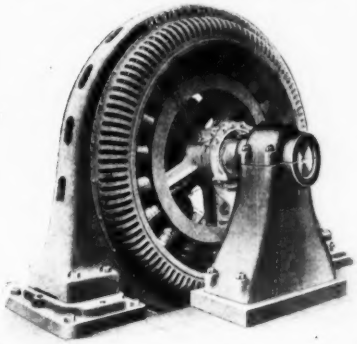

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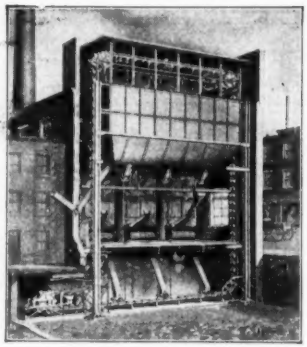

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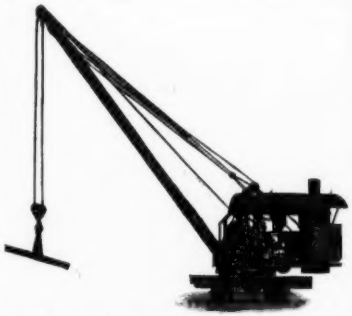

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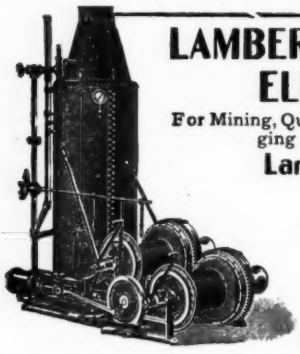

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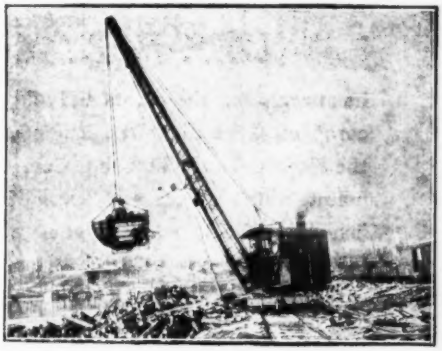

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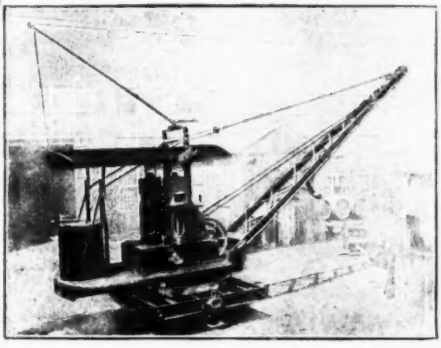

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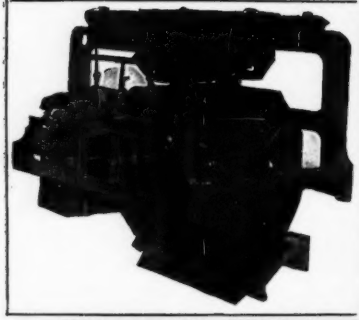

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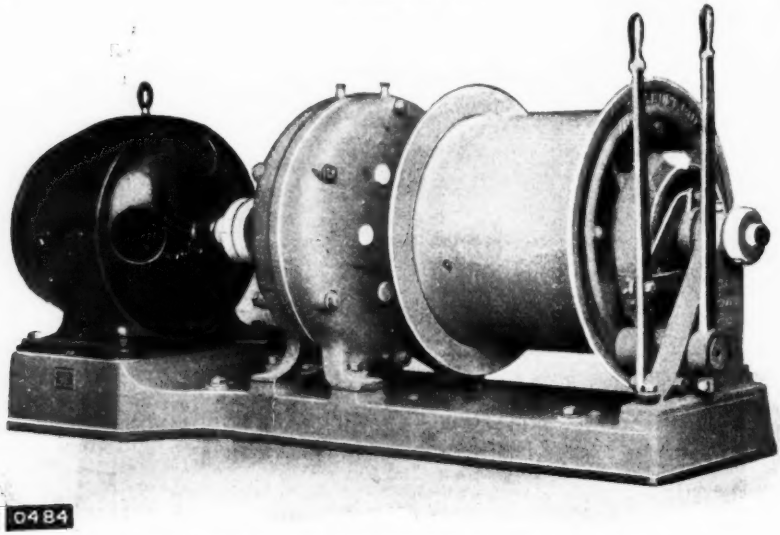

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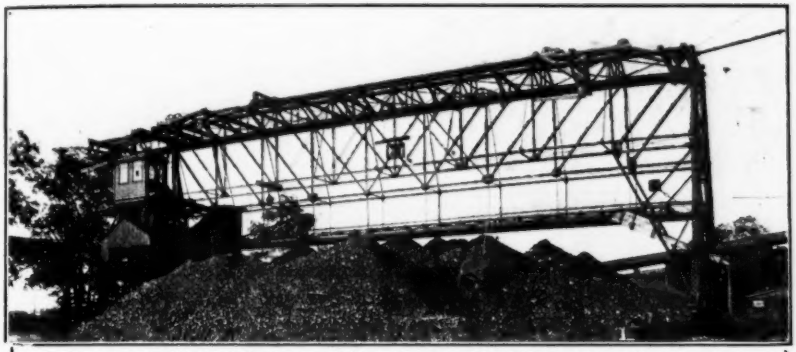

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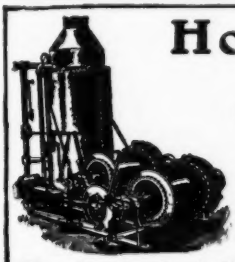

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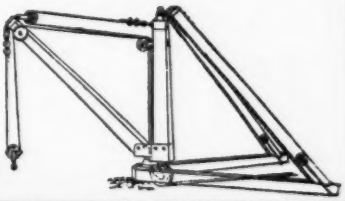

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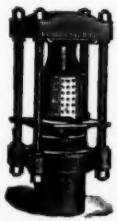

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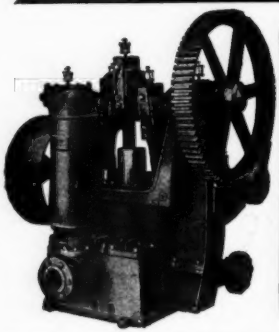

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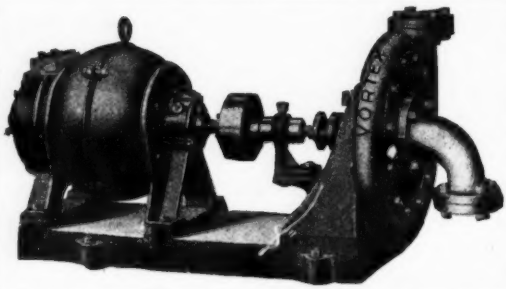

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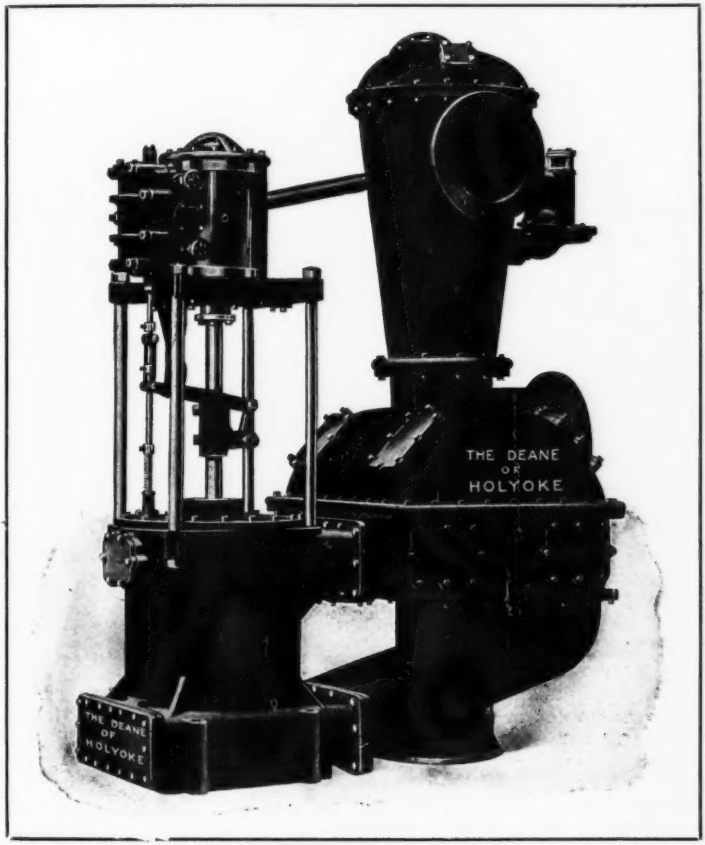

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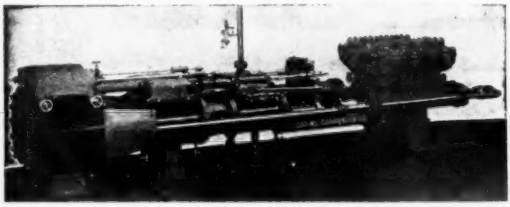

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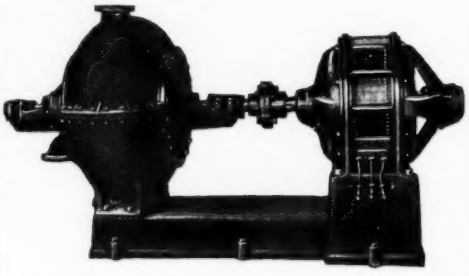

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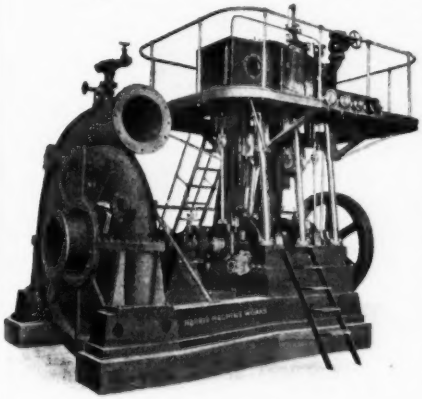

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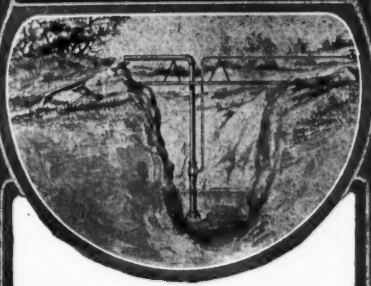

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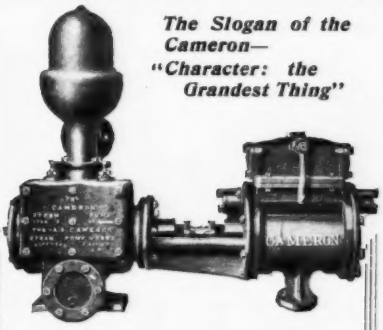

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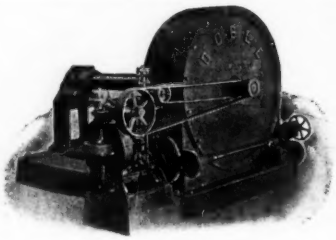

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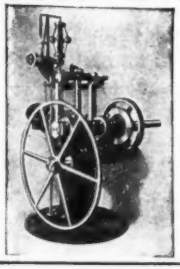

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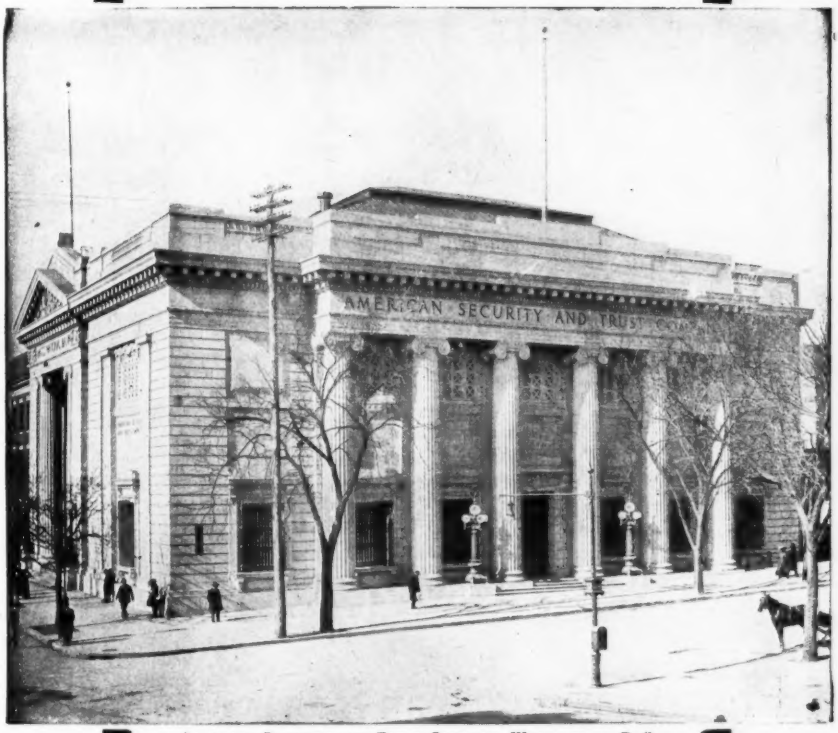

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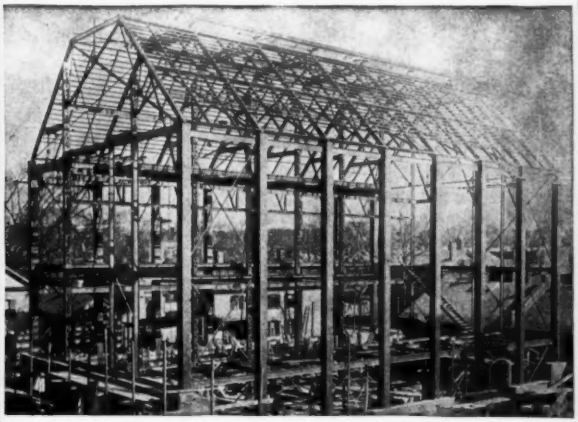

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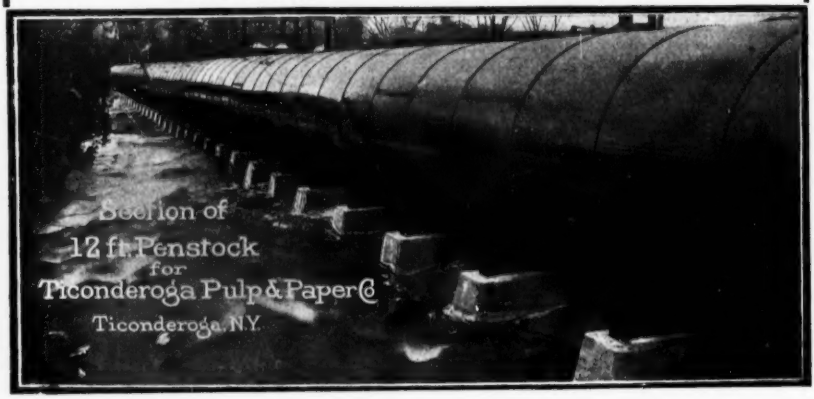

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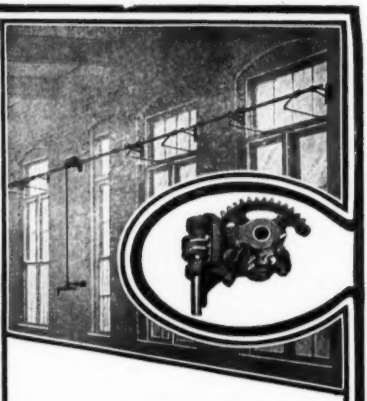

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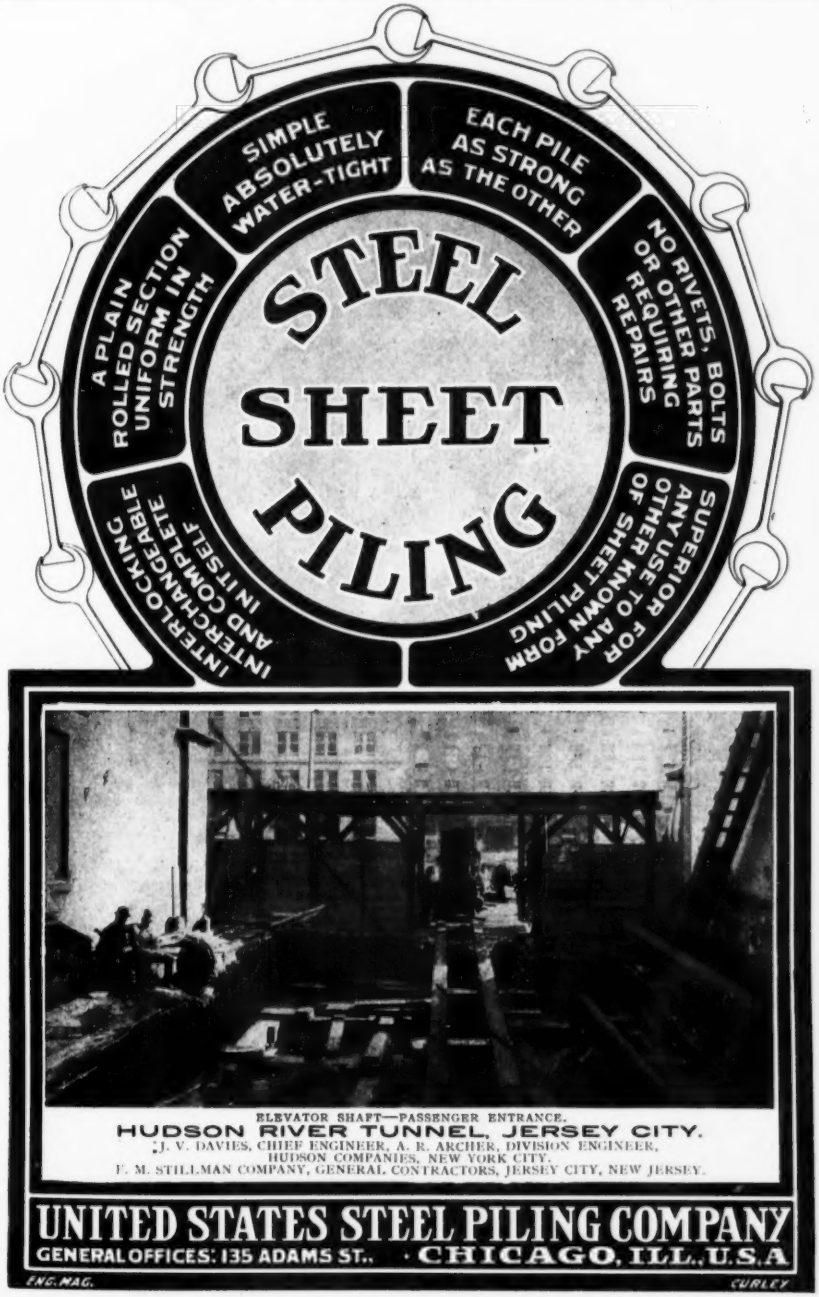
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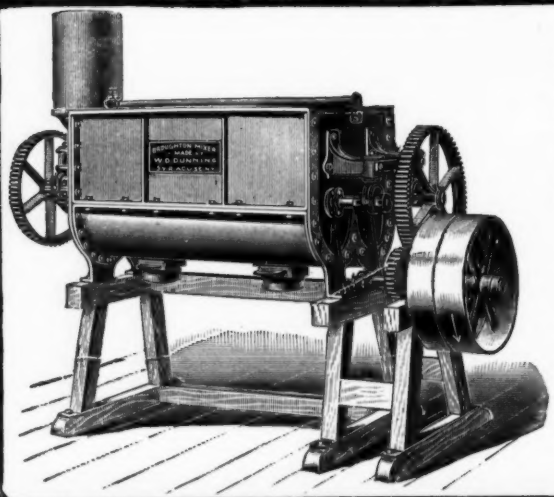

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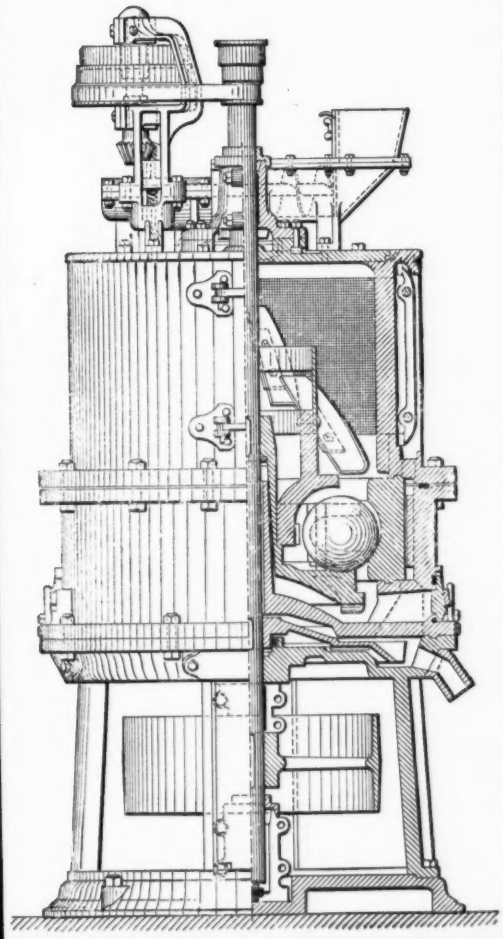

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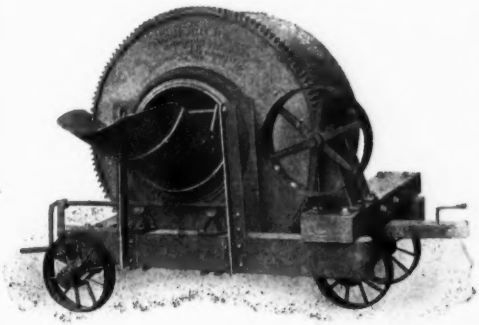

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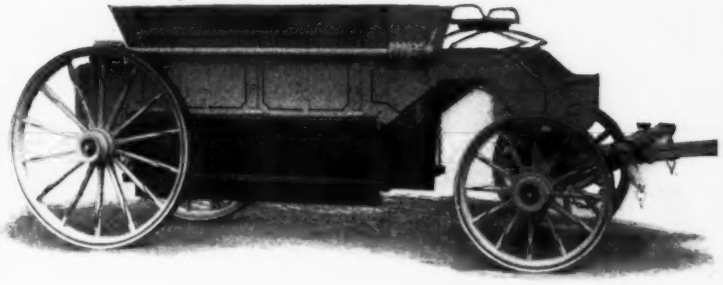

subjected, and the degree of this springing finally becomes so great that gravel or broken stone will drop through the joint between the bottom doors. Then the teamster has to lay gunny sacks, old blankets, etc., over the bottom of the dump wagon if he wishes to haul anything but bricks in it. Very often the teamster forgets to do so, and the wagon goes along like a big hour-glass, spilling its sand or stone upon the road. This will be denied, but we ask you to look for yourself, study all dump wagons a little, and then study the Troy. To facilitate this study send for our Catalog No. 2-EM. It explains why the Troy is the only bottom dump wagon that is invariably sand-tight. It also explains why the dumping mechanism of the Troy is the simplest made.

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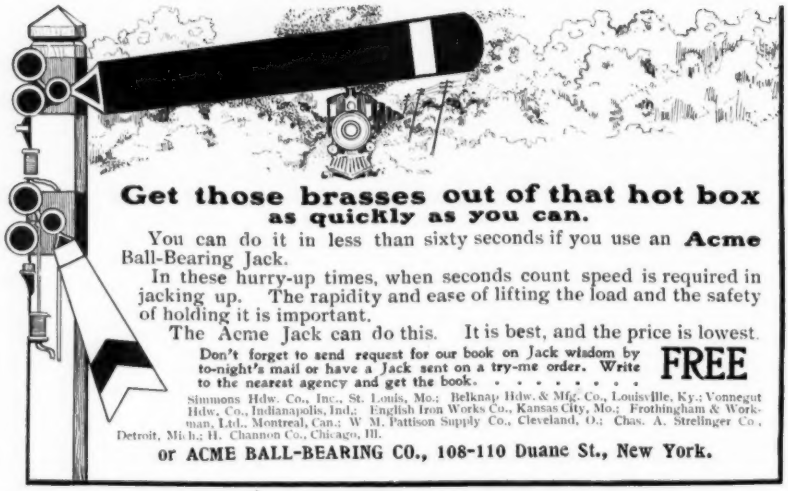

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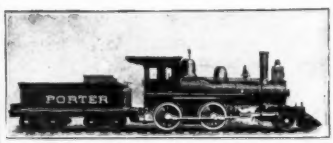

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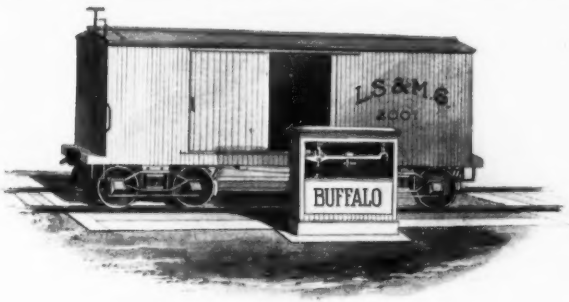

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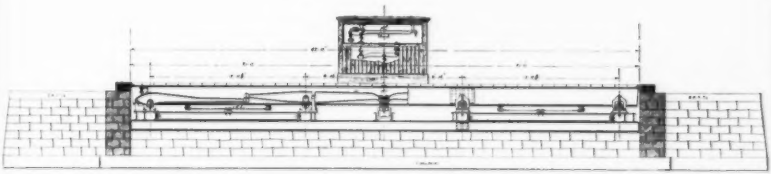

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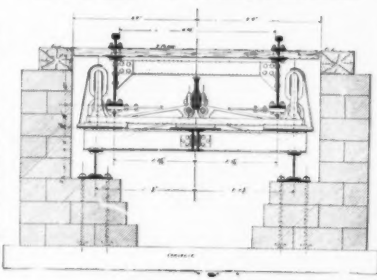

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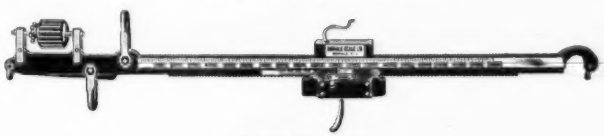

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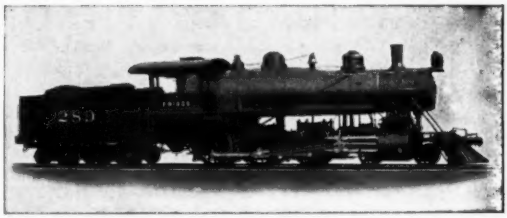

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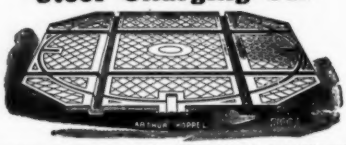

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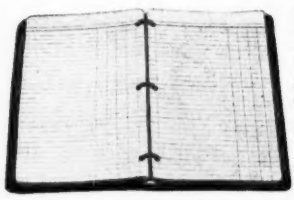

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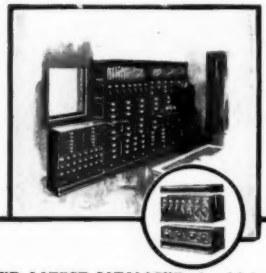

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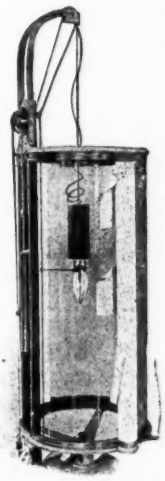

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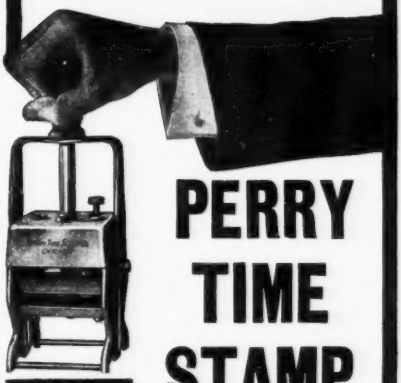

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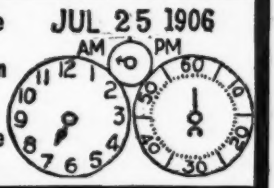

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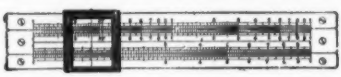

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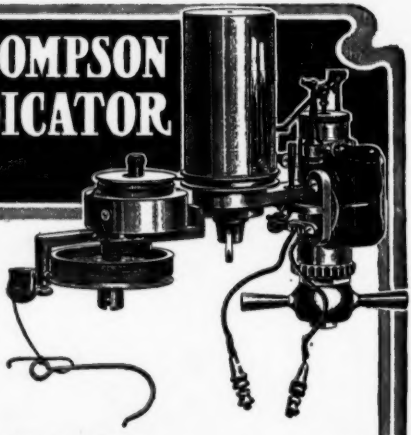

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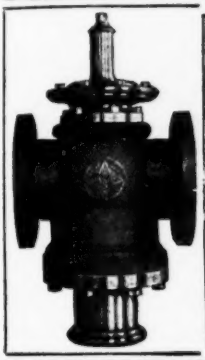

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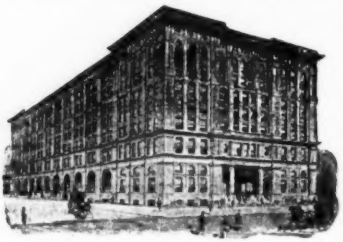

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LOUIS BELL, Ph. D. (*Wake Up, America! Manufacturing Methods which are Perils to Trade*)—Graduated from Dartmouth College, 1884, and took the degree of Ph. D. at Johns Hopkins University, 1888; professor of Physics and Applied Electricity at Purdue University, Lafayette, Ind., 1888-89; consulting engineer, Chicago (firm of Bliss & Bell), 1889; editor of *The Electrical World*, N. Y., 1890-92; member A. I. E. E., 1890; engineer in charge of power-transmission work of the General Electric Co., 1892-95; at present consulting engineer, Boston, Mass., making a specialty of power transmission and heavy electric-railway work. Dr. Bell's wide range of experience in all fields of electric practice enables him to discuss his topic with matchless authority.

EDWIN J. PRINDLE (*Patents as a Factor of Success in a Manufacturing Business*)—Born in Washington, D. C., in 1868; educated in the public and private schools of that city with the ultimate view of the practice of patent law; entered Lehigh University in 1886 and was graduated in 1890 with the degree of mechanical engineer; in the same year entered the United States Patent Office, as assistant examiner. In 1894 he received the degree of Master of Laws from the National University Law School, of Washington, D. C., and has since been admitted to the various courts of that city, being finally finally admitted to the Supreme Court of the United States. At present a member of the New York bar, practicing as a patent attorney in New York City.

WILLIAM M. BARR (*The Mechanical Uses of Water under Pressure*)—A Pennsylvanian by birth; entered the Engineering Corps of the U. S. Navy during the Civil War; resigned several years later by reason of severe illness contracted during service on the Isthmus of Panama. Designed the engines and started the methods employed by the Atlas Engine Works, Indianapolis, Ind.; afterwards superintendent of Henry R. Worthington Hydraulic Works, New York; organized the Barr Pumping Engine Co., Philadelphia; upon the breaking out of the Spanish-American War, he was assigned to duty at League Island Navy Yard, and afterward transferred to Boston Navy Yard. Mr. Barr is now the director of the New York School of Technology.

CHARLES V. ALLEN (*Electric Machinery for the Operation of Mexican Mines*)—Born, Holliston, Mass., July 7, 1869; resided Pasadena, Cal., 1885-1889; entered Massachusetts Institute of Technology, Boston, Mass., 1889; graduated, 1893, with degree of S. B. in Electrical Engineering. Since with the Westinghouse Electric and Mfg. Co., student course, testing departments, foreign and export sales offices.

ALBERT W. THOMPSON (*Systems for Simplifying Shop Supervision*)—Born in 1874; graduated from the Massachusetts Institute of Technology in 1896; has been in the employ of the Amoskeag Manufacturing Company for the past ten years, the last six years of this period in the capacity of superintendent of the company's machine shop; a junior member of the American Society of Mechanical Engineers.

AUTHORS AND PAPERS FOR SEPTEMBER, 1906.

F. H. LEWIS (*Machinery and Processes for a Modern Portland-Cement Plant*)—Graduated in civil engineering, University of Pennsylvania, 1878; 1877-1882, assistant engineer, Pennsylvania Co.; 1882-1885, superintendent of bridge building, Northern Pacific Ry.; 1886, resident engineer, South Pennsylvania Ry., West Dublin, Pa.; 1887-1892, manager Pittsburg Testing Laboratory, Phila.; 1892-1899, member of firm of Booth, Garrett and Blair, in charge of engineering department; 1899-1905, manager Virginia Portland Cement Co., Fordwick, Va.; 1905 to date, consulting engineer, Staunton, Va.; member American Society of Civil Engineers, of Engineers' Clubs of New York and Philadelphia, and of the Engineering Association of the South; spent much time in Europe in 1892 and 1897 investigating the cement industry; designed and built the Martins Creek, Virginia Portland, and Pacific Portland plants and is now building the Standard Portland-cement plant at Leeds, Ala.

HENRY W. JACOBS (*Organization and Economy in the Railway Machine Shop*)—Born 1874; 1888-1894, apprentice, machinist, moulder, structural iron worker, with the Seaton Foundry, Atchison, Kansas; machinist with the U. S. Gun Shop, Washington, D. C.; marine experience with U. S. Government, testing engines, trial runs, etc.; machine and erecting machinist, with the Sprague Electric Company, R. Hoe and Company, and Crocker & Wheeler; 1899, manager, Vulcan Engineering Company, engaged in repairs and building of stationary and marine machinery; 1900, took up railway work as erecting machinist, K. C. S. J. & C. B. Ry. Tool-room foreman, Burlington Railroad; general shop demonstrator, Union Pacific Railroad, and now engineer of methods for one of the largest railway systems in the western United States; member, American Society of Mechanical Engineers.

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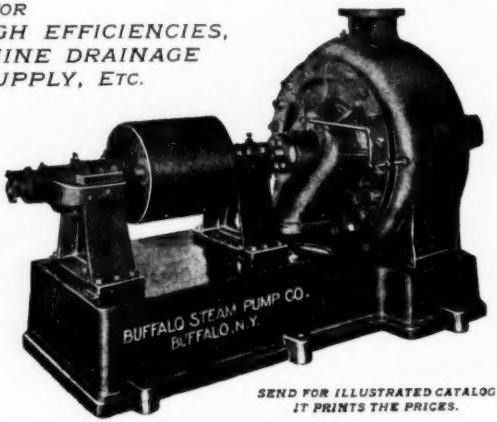

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Buffalo Foundry Co., Buffalo.
H. W. Caldwell & Son Co., Chicago.
Stanley G. Flagg & Co., Phila.
Jeffrey Mfg. Co., Columbus.
Mecklenburg Iron Works, Charlotte, N. C.
Poole Eng'g & Mch. Co., Baltimore.
Southwalk Fdy. & Mch. Co., Phila.
Walworth Mfg. Co., Boston.
Robt. Wetherill & Co., Chester, Pa.

Cast-Iron Pipe.

U. S. Cast Iron Pipe & Fdy. Co., Phila.
Walworth Mfg. Co., Boston.
R. D. Wood & Co., Phila.

Cement Machinery.

Allis-Chalmers Co., Milwaukee.
Bethlehem Fdy. & Mch. Co., So. Bethlehem, Pa.
H. W. Caldwell & Sons Co., Chicago.
W. D. Dunning, Syracuse, N. Y.
Jeffrey Mfg. Co., Columbus.
Lehigh Car, Wheel & Axle Works, Catasauqua, Pa.
Link-Belt Co., Phila.
Mead-Morrison Mfg. Co., Boston.
Ransome Concrete Mchy. Co., N. Y.
Robins Conveying Belt Co., N. Y.
F. L. Smidth & Co., New York.
Sturtevant Mill Co., Boston.
Vulcan Iron Works, Wilkes-Barre, Pa.

Cement, Portland.

Alsen's Am. Portland Cement Co., New York.
American Cement Co., Phila.
Atlas Portland Cement Co., N. Y.
Coplay Cement Mfg. Co., New York.
Electric Welding Mfg. Co., Pittsburg.
Kelley Isl. Lime & Trans. Co., Cleveland.

Chains.

Diamond Chain & Mfg. Co., Indianapolis.
Morse Chain Co., Trumansburg, N. Y.

Chain Belting.

H. W. Caldwell & Sons Co., Chicago.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.
Morse Chain Co., Trumansburg, N. Y.

Chain Joint.

Morse Chain Co., Trumansburg, N. Y.

Channeling Machines.

Ingersoll-Rand Co., New York.

Checks, Time, Pay & Trade.

Sullivan Machinery Co., Chicago.
American Ry. Supply Co., New York.
Schwerdtle Stamp Co., Bridgeport.

Chemicals.

Roessler & Hasslacher Chem. Co.,

Chemists.

Chas. Catlett, Staunton, Va.
Robt. W. Hunt & Co., Chicago.

Chucks.

Almond Mfg. Co., Brocklyn.
American Tool & Mch. Co., Boston.
Niles-Bement-Pond Co., New York.

Clutches, Magnetic.

Elec. Controller & Supply Co., Cleveland.

Clutch Pulleys.

H. W. Caldwell & Sons Co., Chicago.

Coal and Ashes-Handling Machinery.

Browning Engineering Co., Cleveland.
H. W. Caldwell & Sons Co., Chicago.
Hayward Co., New York.
C. W. Hunt Co., New York.
Jeffrey Mfg. Co., Columbus.
Arthur Koppel Co., New York.
Lidgerwood Mfg. Co., New York.
Link-Belt Eng'g Co., Phila.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.
Webster Mfg. Co., Chicago.

Coal Cutters (Air and Electric).

Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago.

Coal and Ore Bunkers.

A. Samuel Berquist, Brooklyn.

Coal Scale.

Richardson Scale Co., New York.

Coal Weighing Machine, Automatic.

Richardson Scale Co., New York.

Coal-Mining Machinery.

Allis-Chalmers Co., Milwaukee.
Geo. F. Blake Mfg. Co., New York.
General Electric Co., New York.
C. W. Hunt Co., New York.
Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus.
Knowles Steam Pump Wks., N. Y.
Arthur Koppel Co., New York.
Laidlaw-Dunn-Gordon Co., New York.
Lambert Hoist. Engine Co., Newark.
Link-Belt Eng'g Co., Phila.
John H. McGowan Co., Cincinnati.
Norwalk Iron Wks., So. Norwalk, Ct.
Robins Conveying Belt Co., N. Y.
Sullivan Machinery Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Henry R. Worthington, New York.

Coal Screens.

Allis-Chalmers Co., Milwaukee.
Hendrick Mfg. Co., Carbondale, Pa.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.
W. S. Tyler Co., Cleveland.

Coil Pipe.

Whitlock Coil Pipe Co., Hartford.

Cold Saw Cutting-off Mchs.

Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.

Commercial Trucks, Gasoline.

Industrial Engineering Co., Cleveland.
Knox Motor Truck Co., Springfield, Mass.

Comptometers.

Felt & Tarrant Mfg. Co., Chicago.

Concrete Block Machines.

Century Cement Machine Co., Rochester.

Concrete Mixers.

W. D. Dunning, Syracuse, N. Y.
Ransome Concrete Mchy. Co., N. Y. York.

Condensers.

Alberger Condenser Co., New York.
Allis-Chalmers Co., Milwaukee.
Geo. F. Blake Mfg. Co., New York.
Deane Steam Pump Co., New York.
Epping-Carpenter Co., Pittsburg.
Guild & Garrison, Brooklyn.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., N. Y.
John H. McGowan Co., Cincinnati.
Platt Iron Works, Dayton, Ohio.
Snow Steam Pump Wks., New York.
Southwark Fdy. & Mch. Co., Phila.
Struthers-Wells Co., Warren, Pa.
Wheeler Condenser & Eng'g Co., N.Y.
Henry R. Worthington, New York.

Continuous Elevators.

H. W. Caldwell & Son Co., Chicago.

Contractors, General.

Miller-Collins Co., New York.
Ransome & Smith Co., N. Y.
Trussed Concrete Steel Co., Detroit.
Turner Construction Co., New York.
J. G. White & Co., New York.

Conduit Systems.

G. M. Gest, New York.

Controllers.

Cutler-Hammer Mfg. Co., Milwaukee.
Elec. Controller & Supply Co., Cleveland.

Conveying Machinery.

Allis-Chalmers Co., Milwaukee.
H. W. Caldwell & Sons Co., Chicago.
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Wheeler Condenser & Eng'g Co., N. Y.
Henry R. Worthington, New York.

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American Mfg. Co., New York.

Cost Systems.
Baker-Vawter Co., Chicago.
John A. Cooper, Chicago.
Gunn, Richards & Co., New York.
C. K. Hooper, New York.
Stephen T. Williams, New York.

Cotton Oil Machinery.
Laidlaw-Dunn-Gordon Co., New York.
Platt Iron Works, Dayton, Ohio.

Couplings.
Almond Mfg. Co., Brooklyn.

Cranes.
Brown Hoist. Mch. Co., N. Y.
Browning Engineering Co., Cleveland.
Cleveland Crane & Car Co., Wickliffe, O.
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Maris Bros., Philadelphia.
Niles-Bement-Pond Co., New York.
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Crane Scales.,
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Crucibles.
Jos. Dixon Crucible Co., Jersey City.
S. Obermayer Co., Cincinnati.
J. D. Smith Fdy. Supply Co., Cleveland.

Crusher, Ore, Phosphate, Rock.
Allis-Chalmers Co., Milwaukee.
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
F. L. Smidth & Co., New York.
Lehigh Car, Wheel & Axle Works, Catasauqua, Pa.
Sturtevant Mill Co., Boston.

Cupolas.
S. Obermayer Co., Cincinnati.
Riter-Conley Mfg. Co., Pittsburg.

Cutters, Milling.
Becker-Brainard Mill Mch. Co., Hyde Park, Mass.
Pratt & Whitney Co., Hartford.

Dams, Concrete.
Electric Welding Mfg. Co., Pittsburg.

Derricks and Fittings.
Contractors' Plant Mfg. Co., Buffalo.

Digesters.
Atlantic Works, East Boston, Mass.
Riter-Conley Mfg. Co., Pittsburg.
Tippett & Wood, Phillipsburg, N. J.
Robt. Wetherill & Co., Chester, Pa.

Draft, Mechanical.
B. F. Sturtevant Co., Hyde Park, Mass.

Drilling Machines.
W. F. & J. Barnes Co., Rockford, Ill.
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
Chicago Pneu. Tool Co., Chicago.
Jas. Clark, Jr., & Co., Louisville.
Cleveland Pneu. Tool Co., Cleveland.
Ingersoll-Rand Co., New York.
Keystone Driller Co., Beaver Falls, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
William Sellers Co., Inc., Phila.
Stow Flexible Shaft Co., Phila.
Stow Mfg. Co., Binghamton, N. Y.

Drills, Diamond Core.
Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago.

Drills—Rock and Coal.
Am. Diamond Rock Drill Co., N. Y.
Chicago Pneumatic Tool Co., Chicago.
Clayton Air Compress Wks., N. Y.
Hall Steam Pump Co., Pittsburg.
Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus
Keystone Driller Co., Beaver Falls, Pa.
F. L. Smidth & Co., New York.
Sullivan Machinery Co., Chicago.
Wood Drill Works, Paterson.

Drop Forgings.
Anderson Forge & Machine Co., Detroit, Mich.
Chicago Drop Forge & Fdy Co., Kensington, Ill.
Wyman & Gordon, Worcester, Mass.

Drop Hammers.
Williams, White & Co., Moline.

Drying Apparatus.
Buffalo Forge Co., Buffalo.
B. F. Sturtevant Co., Hyde Park, Mass.
Philadelphia Drying Mchy. Co., Phila.

Dumps, Automatic.
Sullivan Machinery Co., Chicago.

Dump Wagons.
Troy Wagon Works Co., Troy, Ohio.

Dynamos.
Allis-Chalmers Co., Milwaukee.
Am. Engine Co., Bound Brook, N. J.
Crocker-Wheeler Co., Ampere, N. J.
C & C Electric Co., New York.
General Electric Co., New York.
Jeffrey Mfg. Co., Columbus.
Northern Elec. Mfg. Co., Madison.
Sprague Electric Co., New York.
B. F. Sturtevant Co., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Western Electric Co., Chicago.

Dynamos, Steam Turbine.
De La Val Steam Turbine Co., Trenton.

Elbows, Pipe.
Whitlock Coil Pipe Co., Hartford.

Electric Bells.
W. R. Ostrander & Co., New York.
Western Electric Co., Chicago.

Electric Heating Apparatus.
Simplex Elec. Heating Co., Cambridgeport, Mass.
Western Electric Co., Chicago.

Electric Hoists.
Allis-Chalmers Co., Milwaukee.
C & C Electric Co., New York.
C. W. Hunt Co., New York.
Lambert Hoist. Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., Boston.
Mineral Ridge Mfg. Co., Mineral Ridge, Ohio.
Niles-Bement-Pond Co., New York.
Sprague Electric Co., New York.
Western Electric Co., Chicago.

Elec. Measuring Instruments.
Weston Elec. Instrument Co., Waverly Park, Newark, N. J.

Elec. Welding Outfits.
C & C Electric Co., New York.

Electrotypers.
A. Mugford, Hartford.

Elevators.
H. W. Caldwell & Son Co., Chicago.
Electric Welding Mfg. Co., Pittsburg.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.
S. Obermayer Co., Cincinnati.
Poole Eng'g Mch. Co., Baltimore.

Emery Wheels.
Carborundum Co., Niagara Falls.
Stow Flexible Shaft Co., Phila.

Engineering Instruments.
A. S. Aloe Co., St. Louis.
Theo. Alteneder & Sons, Phila.
Brandis Sons Co., Brooklyn.
Buff & Buff Mfg. Co., Boston.
Eugene Dietzgen Co., Chicago.
Keuffel & Esser Co., New York.
Kolesch & Co., New York.
Queen & Co., Phila.

Engineers.
Arnold Co., Chicago.
George M. Brill, Los Angeles.
Abner Doble Co., San Francisco.
Dodge & Day, Philadelphia.
Wm. C. Furber, Philadelphia.
Gunn, Richards & Co., New York.
G. K. Hooper, New York.
Hudson Eng. & Cont. Co., N. Y.
Industrial Engineering Co., Cleveland.
Robt. McF. Doble, Colorado Springs, Colo.
Robt. W. Hunt & Co., Chicago.
F. E. Junge & Co., New York.
Julian Kennedy, Pittsburg.
Walter Kennedy, Pittsburg.
G. W. McClure, Son & Co., Pittsburg.
H. F. J. Porter, New York.
W. K. Palmer, Kansas City.
Power Installation Co., Buffalo.
A. W. Robinson, Montreal, Canada.
H. B. Roelker, New York.
J. G. White & Co., New York.

Engineers, Foreign.
O. C. Roedder, Karlsruhe, Germany.

Engines, Blowing.
Allis-Chalmers Co., Milwaukee.
American Blower Co., Detroit.
Platt Iron Works, Dayton, Ohio.
Southwark Fdy. & Mch. Co., Phila.
Sprague Elec. Co., New York.

Engines, Marine.
Atlantic Works, East Boston, Mass.

Engines—Gas and Gasoline.
Allis-Chalmers Co., Milwaukee.
De La Vergne Machine Co., N. Y.
Fairbanks Co., New York.
Snow Steam Pump Wks., New York.
Struthers-Wells Co., Warren, Pa.
Westinghouse Mch. Co., Pittsburg.
Westinghouse, Church, Kerr & Co., New York.

Engines, Steam.
Allis-Chalmers Co., Milwaukee.
American Blower Co., Detroit.
Am. Engine Co., Bound Brook, N. J.
Ball Engine Co., Erie, Pa.
Geo. F. Blake Mfg. Co., New York.
Buckeye Engine Co., Salem, O.
Buffalo Forge Co., Buffalo.
Frick Co., Waynesboro, Pa.
Hooven, Owens, Rentschler Co., Hamilton.
Mecklenburg Iron Wks., Charlotte, N. C.
Providence Eng'g Wks., Providence.
Shepherd Eng'g Co., Franklin, Pa.
Southwark Fdy. & Mch. Co., Phila.
Struthers-Wells Co., Warren, Pa.
B. F. Sturtevant Co., Hyde Park, Mass.
Westinghouse Mch. Co., Pittsburg.
Westinghouse, Church, Kerr & Co., New York.
Robt. Wetherill & Co., Chester, Pa.

Engravers.
A. Mugford, Hartford.

Evaporators.
Geo. F. Blake Mfg. Co., New York.
Knowles Steam Pump Wks., N. Y.

Excavators.
Allis-Chalmers Co., Milwaukee.
Bucyrus Co., So. Milwaukee, Wis.
Hayward Co., The, New York.
Jeffrey Mfg. Co., Columbus.
Marion Steam Shovel Co., Marion, O.
Robins Conveying Belt Co., N. Y.

Exhaust Heads.
Am. Spiral Pipe Wks., Chicago.
Direct Separator Co., Syracuse.
Hoppes Mfg. Co., Springfield, O.
Pittsburg Gage & Supply Co., Pittsburg.
B. F. Sturtevant Co., Hyde Park, Mass.
Watson & McDaniel Co., Phila.
Wright Mfg. Co., Detroit.

Expanded Metal.
Associated Expanded Metal Cos., N. Y.
Roebling Construction Co., N. Y.

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Stromberg-Carlson Tel. Mfg. Co., Rochester.

Fans, Ventilating.
Allis-Chalmers Co., Milwaukee.
American Blower Co., Detroit.
Buffalo Forge Co., Buffalo.
Green Fuel Economizer Co., Matteawan, N. Y.
Philadelphia Drying Mchy. Co., Philadelphia.
Power Specialty Co., New York.
Sprague Electric Co., New York.
B. F. Sturtevant Co., Hyde Park, Mass.
Sullivan Machinery Co., Chicago.
Western Electric Co., Chicago.

Fans, Electric.
Diehl Mfg. Co., Elizabethport, N. J.
Philadelphia Drying Mchy. Co., Phila.
Western Electric Co., Chicago.

Feed-Water Heaters and Purifiers.
Allis-Chalmers Co., Milwaukee.
Geo. F. Blake Mfg. Co., New York.
I. B. Davis & Son, Hartford.
Goubert Mfg. Co., New York.
Green Fuel Economizer Co., Matteawan, N. Y.
Harrison Safety Boiler Wks., Phila.
Hoppes Mfg. Co., Springfield, O.
Knowles Steam Pump Wks., N. Y.
John H. McGowan Co., Cincinnati.
The Petroleum Iron Works Co., Washington, Pa.
Platt Iron Works Co., Dayton.
Providence Eng'g Wks., Providence.
Ross Valve Co., Troy.
Wm. B. Scaife & Sons Co., Pittsburg.
Stewart Heater Co., Buffalo.
Warren Webster & Co., Camden, N. J.
Whitlock Coil Pipe Co., Hartford.
Robt. Wetherill & Co., Chester, Pa.
Wheeler Condenser & Eng'g Co., N. Y.
Henry R. Worthington, New York.

Feed Water Regulators.
Williams Gauge Co., Pittsburg.
Chaplin-Fulton Mfg. Co., Pittsburg.
Strong, Carlisle & Hammond Co., Cleveland.

Felt, Waterproof.
Hydrex Felt & Eng'g Co., New York.

Files and Rasps.
G. & H. Barnett Co., Phila.
Nicholson File Co., Providence.

Filing Cabinets.
Globe-Wernicke Co., Cincinnati.

Filter Presses.
Am. Tool & Machine Co., Boston.
Niles-Bement-Pond Co., New York.

Filters.
L. O. Koven & Bro., New York.
Ross Valve Co., Troy.
Wm. B. Scaife & Sons Co., Pittsburg.
Robt. Wetherill & Co., Chester, Pa.

Fire Brick.
Henry Maurer & Son, New York.
S. Obermayer Co., Cincinnati.

Fireproof Building Materials.
Associated Expanded Metal Co., N. Y.
Clinton Wire Cloth Co., New York.
Electric Welding Mfg. Co., Pittsburg.
Henry Maurer & Son, New York.
Roebling Construction Co., New York.

Fireproof Construction.
Electric Welding Mfg. Co., Pittsburg.

Flanges—Forged Steel.
Am. Spiral Pipe Wks., Chicago.

Flexible Shafts.
Chicago Flexible Shaft Co., Chicago.
Stow Flexible Shaft Co., Phila.
Stow Mfg. Co., Binghamton, N. Y.

Flexible Steel Tubing.
Almond Mfg. Co., Brooklyn.

Float Valves.
Foster Eng'g Co., Newark.

Floor and Sidewalk Lights.
T. H. Brooks & Co., Cleveland.

Fly Wheels.
Allis-Chalmers Co., Milwaukee.
Poole Eng'g & Mch. Co., Baltimore.
Robt. Wetherill & Co., Chester, Pa.

Foreign Representation.
O. C. Roedder, Karlsruhe, Germany.

Forges.
Buffalo Forge Co., Buffalo.
Ingersoll-Rand Co., New York.
B. F. Sturtevant Co., Hyde Park, Mass.

Forgings, Iron and Steel.
Anderson Forge & Machine Co., Detroit, Mich.
Chicago Drop Forge & Fdy. Co., Kensington, Ill.
Wyman & Gordon, Worcester.

Foundry Equipment.
Am. Air Compressor Wks., New York.
Birdsboro Steel Fdy. & Mfg. Co., Birdsboro, Pa.
Geo. F. Blake Mfg. Co., New York.
Buffalo Foundry Co., Buffalo.
C. W. Hunt Co., New York.
Ingersoll-Rand Co., New York.
Arthur Kompel Co., New York.
S. Obermayer Co., Cincinnati.

Foundry Supplies.
Ingersoll-Rand Co., New York.
S. Obermayer Co., Cincinnati.

Friction Clutches.
Am. Tool & Mch. Co., Boston.
H. W. Caldwell & Son Co., Chicago.
Cutler-Hammond Mfg. Co., Milwaukee.
Elec. Controller & Supply Co., Cleveland.
Link-Belt Eng'g Co., Phila.
Poole Eng'g & Mch. Co., Baltimore.

Fuel Economizers.
Green Fuel Economizer Co., Matteawan, N. Y.
Providence Eng'g Wks., Providence.
B. F. Sturtevant Co., Hyde Park, Mass.

Furnace Builders.
Am. Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago.
Continental Iron Wks., Brooklyn.
Julian Kennedy, Pittsburg.
G. W. McClure, Son & Co., Pittsburg.
Morgan Const. Co., Worcester.
Riter-Conley Mfg. Co., Pittsburg.

Gages — Pressure, Steam, Water.
Am. Steam Gauge & Valve Co., Boston.
Ashcroft Mfg. Co., N. Y.
Ashton Valve Co., Boston.
Bristol Co., Waterbury Conn.
Hohmann & Maurer Mfg. Co., Rochester.
Lunkenheimer Co., Cincinnati.
Manning, Maxwell & Moore, N. Y.
Pittsburg Gage & Supply Co., Pittsburg.
Star Brass Mfg. Co., Boston.
Walworth Mfg. Co., Boston.

Galvanizing.
L. O. Koven & Bro., New York.

Gasoline Commercial Trucks.
Knox Motor Truck Co., Springfield, Mass.

Gas Arc Lamps.
General Gas Light Co., Kalamazoo, Mich.

Gas Machines & Generators.
Am. Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago.
Link-Belt Co., Phila.
Morgan Const. Co., Worcester.
Wile Power Gas Co., Rochester.
R. D. Wood & Co., Phila.
Walworth Mfg. Co., Boston.

Gas Blowers and Exhausters.
B. F. Sturtevant Co., Hyde Park, Mass.

Gas Producers.
Morgan Construction Co., Worcester.
Wile Power Gas Co., Rochester.

Gaskets.
Am. Spiral Pipe Wks., Chicago.
Boston Belting Co., Boston.

Gear Cutting Machines.
Becker-Brainard Mill. Mch. Co., Hyde Park, Mass.
Pratt & Whitney Co., Hartford.

Gearing.
Hugo Bilgram, Phila.
Geo. F. Blake Mfg. Co., New York.
Buffalo Gear & Pattern Wks., Buffalo.
H. W. Caldwell & Son Co., Chicago.
Wm. Ganschow, Chicago.
Jeffrey Mfg. Co., Columbus.
New Process Rawhide Co., Syracuse.
R. D. Nuttall Co., Pittsburg.
Poole Eng'g & Mch. Co., Baltimore.
Wm. Sellers Co., Inc., Phila.
Stow Flexible Shaft Co., Phila.
Robt. Wetherill & Co., Chester, Pa.

Generating Sets.
Allis-Chalmers Co., Milwaukee.
B. F. Sturtevant Co., Hyde Park, Mass.
Western Electric Co., Chicago.

Gold Dredging Machinery.
Allis-Chalmers Co., Milwaukee.
Jos. Dixon Crucible Co., Jersey City.
S. Obermayer Co., Cincinnati.
Risdon Iron Works, San Francisco.

Graphite.
National Paint Works, Williamsport, Pa., and New York.

Grates, Traveling Link.
Green Engineering Co., Chicago.

Grinding Machinery.
Western Electric Co., Chicago.

Grinding & Polishing Mchy.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Jas. Clarke, Jr., & Co., Louisville.
Crocker-Wheeler Co., Ampere, N. J.
Landis Tool Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison.
Pratt & Whitney Co., Hartford.
F. L. Smidth & Co., New York.
Sturtevant Mill Co., Boston.
Stow Flexible Shaft Co., Phila.
William Sellers Co., Inc., Phila.

Hack Saws.
Diamond Saw & Stamping Works, Buffalo.
Niles-Bement-Pond Co., New York.

Hammers, Electric.
Northern Elec. Mfg. Co., Madison.

Heading & Upsetting Mchy.
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Sprague Elec. Co., New York.
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B. F. Sturtevant Co., Hyde Park, Mass.
Walworth Mfg. Co., Boston.
Warren Webster & Co., Camden, N. J.
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High Pressure Steel Fittings.
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.

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Link-Belt Co., Phila.
Mead-Morrison Mfg. Co., Boston.
Providence Eng'g Works, Providence.
Robins Conveying Belt Co., N. Y.
William Sellers Co., Inc., Phila.
Sprague Elec Co., New York.
Sullivan Machinery Co., Chicago.
Trenton Iron Co., Trenton, N. J.
Vulcan Iron Wks., Wilkes-Barre, Pa.
Western Electric Co., Chicago.

Hoisting Rope.

American Mfg. Co., New York.

Hollow Concrete Building Block Machines.

Century Cement Machine Co., Rochester.

Hose.

Chicago Pneumatic Tool Co., Chicago.
Boston Belting Co., Boston.
Eureka Fire Hose Co., New York.

Hydraulic Machinery.

Allis-Chalmers Co., Milwaukee.
Goulds Mfg. Co., Seneca Falls, N. Y.
Niles-Bement-Pond Co., New York.
Phila. Drying Mchy. Co., Phila.
Platt Iron Works, Dayton, Ohio.
Williams, White & Co., Moline.

Hydraulic Rams.

Pelton Water Wheel Co., San Francisco.
Power Specialty Co., New York.

Ice-Mak'g & Refriger. Mchy.

De La Vergne Machine Co., N. Y.
Frick Co., Waynesboro, Pa.

Indicators.

H. B. Roelker, New York.
American Steam Gauge & Valve Mfg. Co., Boston.
Ashcroft Mfg. Co., N. Y.

Internal Gearing.

Wm. Ganschow Chicago.
R. D. Nuttall Co., Pittsburg.

Iron and Bronze, Ornamental.

W. S. Tyler Co., Cleveland.

Jacks.

Acme Ball Bearing Co. N. Y.

Jacks, Hydraulic.

Watson-Stillman Co., New York.

Kiln

Vulcan Iron Wks., Wilkes-Barre, Pa.

Lamps, Electric.

General Electric Co., New York.
Sawyer-Man Elec. Co., Pittsburg.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Western Electric Co., Chicago.

Lamps, Shop.

General Gas Light Co., Kalamazoo, Mich.

Lathes.

American Tool & Mch. Co., Boston.
W. F. & J. Barnes Co., Rockford, Ill.
Jones & Lamson Mch. Co., Springfield, Vt.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
William Sellers Co., Inc., Phila.

Law, Mining.

John J. Cushing, New York.

Leather Packing.

Detroit Leather Specialty Co., Detroit.

Lift Bridges.

Cowing Engineering Co., Cleveland.
Scherzer Rolling Lift Bridge Co., Chicago.

Lifting Magnets.

Elec. Controller & Supply Co., Cleveland.

Light Railways.

C. W. Hunt Co., New York.
Arthur Koppel Co., New York.
Link-Belt Eng'g Co., Phila.
Robins Conveying Belt Co., N. Y.

Lock-Bar Steel Pipe.

East Jersey Pipe Co., New York.

Lockers.—Metal.

Merritt & Co., Phila.

Locomotive Cranes.

Browning Engineering Co., Cleveland.
Industrial Wks., Bay City, Mich.
Mead-Morrison Mfg. Co., Boston.

Locomotives.

American Locomotive Co., New York.
Baldwin Locomotive Wks., Phila.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
C. W. Hunt Co., New York.
Jeffrey Mfg. Co., Columbus.
Arthur Koppel Co., New York.
H. K. Porter Co., Pittsburg.
Robins Conveying Belt Co., N .Y.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Loose-leaf Books.

Sieber & Trussell Mfg. Co., St. Louis.

Lubricants.

Jos. Dixon Crucible Co., Jersey City.
S. Obermayer Co., Cincinnati.

Lubricating & Oiling Devices.

Pittsburg Gage & Supply Co., Pittsburg.

Lubricators.

D. T. Williams Valve Co., Cincinnati.
Greene, Tweed & Co., New York.

Machinery Exhibits.

Bourse, Philadelphia.

Machinery, Second Hand.

Niles-Bement-Pond Co., New York.

Machinists' Small Tools.

Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford.
William Sellers Co., Inc., Phila.

Measuring Tapes.

Kolesch & Co., New York.
Lufkin Rule Co., Saginaw, Mich.

Metal, Expanded.

Associated Expanded Metal Cos., N. Y.

Metal Lath.

Clinton Wire Cloth Co., New York.
Roebling Construction Co., N. Y.

Meters, Electric.

General Electric Co., New York.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Weston Elec. Inst. Co., Waverly Park, Newark, N. J.

Milling Machines.

Adams Co., Dubuque, Iowa.
Becker-Brainard Mill. Mch. Co., Hyde Park, Mass.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

Mill Supplies.

Pittsburg Gage & Supply Co., Pittsburg.
Robins Conveying Belt Co., N. Y.

Mine Cars.

Allis-Chalmers Co., Milwaukee.
C. W. Hunt Co., New York.
Jeffrey Mfg. Co., Columbus.
Arthur Koppel Co., New York.

Mining Law.

John J. Cushing, New York.

Mining Machinery.

Allis-Chalmers Co., Milwaukee.
Am. Diamond Rock Drill Co., N. Y.
Geo. F. Blake Mfg. Co., New York.
Deane Steam Pump Co., New York.
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
General Electric Co., New York.
Goulds Mfg. Co., Seneca Falls, N. Y.
Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus.
Knowles Steam Pump Wks., N. Y.
Arthur Koppel Co., New York.
Laidlaw-Dunn-Gordon Co., New York.
Lambert Hoist. Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.
John H. McGowan Co., Cincinnati.
Mead-Morrison Mfg. Co., Boston.
Mecklenburg Iron Wks., Charlotte, N. C.
Norwalk Iron Wks., So. Norwalk, Ct.
Platt Iron Works, Dayton, Ohio.
Power Specialty Co., New York.
Providence Eng'g Wks., Providence.
Risdon Iron Works, San Francisco.
Robins Conveying Belt Co., N. Y.
F. L. Smidth & Co., New York.
Snow Steam Pump Wks., New York.
Sturtevant Mill Co., Boston.
Sullivan Machinery Co., Chicago.
Trenton Iron Wks. Co., Trenton, N. J.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Henry R. Worthington, New York.

Motors, Electric.

Allis-Chalmers Co., Milwaukee.
Am. Engine Co., Bound Brook, N. J.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Mfg. Co., Milwaukee
Diehl Mfg. Co., Elizabethport, N. J.
Elec. Controller & Supply Co., Cleveland.
General Electric Co., New York.
Jeffrey Mfg. Co., Columbus.
Northern Elec. Mfg. Co., Madison.
Robbins & Myers Co., Springfield, O.
Sprague Electric Co., New York.
Stow Mfg. Co., Binghamton, N. Y.
B. F. Sturtevant Co., Hyde Park, Mass.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Ptitsburg.

Motors, Steam Turbine.

De La Val Steam Turbine Co., Trenton.

Moulding Machines.

Geo. F. Blake Mfg. Co., New York
S. Obermayer Co., Cincinnati.
Power Specialty Co., New York.

Name Plates and Labels.

Am. Ry. Supply Co., New York.
Schwerdtle Stamp Co., Bridgeport.

Naphtha Gas Machines.

Am. Gas Furnace Co., New York.

Nut Tappers.

National Mchy. Co., Tiffin, Ohio.

Office Furniture.

Globe-Wernicke Co., Cincinnati.

Oil Burners.

The Petroleum Iron Works Co., Washington, Pa.

Oil Engines.

De La Vergne Machine Co., N. Y.

Oil Filters.

Pittsburg Gage & Supply Co., Pittsburg.

Oil Refining Plants.

The Petroleum Iron Works Co., Washington, Pa.

Packing.

Boston Belting Co., Boston.
Chaplin-Fulton Mfg. Co., Pittsburgh
Detroit Leather Specialty Co., Detroit.
Jenkins Brothers, New York.

Paint Graphite.

S. Obermayer Co., Cincinnati.
National Paint Works, Williamsport, Pa., and New York.

Paints and Varnishes.

Jos. Dixon Crucible Co., Jersey City.
National Paint Works, Williamsport, Pa., and New York.
Sterling Varnish Co., Pittsburg.
U. S. Paint Co., Williamsport, Pa.

Paper-Mill Machinery.

Geo. F. Blake Mfg. Co., New York.
Deane Steam Pump Co., New York.
Goulds Mfg. Co., Seneca Falls, N. Y.

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Jeffrey Mfg. Co., Columbus.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
Robins Conveying Belt Co., N. Y.
Snow Steam Pump Wks., New York.
Henry Worthington, New York.

Patent Attorneys.

Gustav Ayres, Washington, D. C.
C. A. Dieterich, New York.
Evans, Wilkins & Co., Washington, D. C.
O. J. Haegler, Philadelphia.

Pattern-Makers' Machinery.

Fay & Egan Co., Cincinnati.
Pratt & Whitney Co., Hartford.

Pattern Makers.

Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
Buffalo Gear & Pattern Wks., Buffalo.

Penstocks.

Walsh's Holyoke Steam Boiler Co., Holyoke, Mass.

Perforated Metal.

Allis-Chalmers Co., Milwaukee.
H. W. Caldwell & Son Co., Chicago.
Hendrick Mfg. Co., Carbondale, Pa.

Phosphor Bronze.

Phosphor Bronze Smelt. Co., Phila.
Poole Eng'g & Mch. Co., Baltimore.

Pile Drivers.

Bucyrus Co., So. Milwaukee.
Ingersoll-Rand Co., New York.

Piling, Steel Sheet.

U. S. Steel Piling Co., Chicago.

Pipe.

Am. Spiral Pipe Wks., Chicago.
East Jersey Pipe Co., New York.
L. O. Koven & Bro., New York.
Pelton Water Wheel Co., Oakland, Cal.
The Petroleum Iron Works Co., Washington, Pa.
Pittsburg Gage & Supply Co., Pittsburg.
U. S. Cast Iron Pipe & Fdy. Co., Phila.
Walworth Mfg. Co., Boston.
Whitlock Coil Pipe Co., Hartford.

Pipe Bends.

Walworth Mfg. Co., Boston.
Whitlock Coil Pipe Co., Hartford.

Pipe-Cutting and Threading Machines.

Armstrong Mfg. Co., Bridgeport, Conn.
Cox & Sons Co., Bridgeton, N. J.
Curtis & Curtis Co., Bridgeport, Ct
Niles Bement-Pond Co., New York.
Walworth Mfg. Co., Boston.

Pipe—Spiral Riveted.

Amer. Spiral Pipe Wks., Chicago.

Pipe Fittings, Cast-Iron.

American Spiral Pipe Wks., Chicago.
Pelton Water Wheel Co., San Francisco.
Pittsburg Gage & Supply Co., Pittsburg.
Pittsburg Valve & Fittings Co., Pittsburg.
Walworth Mfg. Co., Boston.

Planers.

Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

Planing Mill Machinery.

Fay & Egan Co., Cincinnati.

Pneumatic Tools.

Am. Air Compress. Wks., N. Y.
Chicago Pneu. Tool Co., Chicago.
Clayton Air Compress. Wks., N. Y.
Curtis & Co. Mfg. Co., St. Louis.
Dayton Pneumatic Tool Co., Dayton.
Ingersoll-Rand Co., New York.

Pop Safety Valves.

Am. Steam Gauge & Valve Co., Boston.
Ashton Valve Co., Boston.
Consolidated Safety Valve Co., N. Y.
Star Brass Mfg. Co., Boston.

Portable Drilling Machines.

Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Star Drilling Machine Co., Akron, O.

Portable Time Stamps and Recorders.

Perry Time Stamp Co., Chicago.

Power Hammers.

Williams, White & Co., Moline.

Power Machinery, Steam or Water.

Allis-Chalmers Co., Milwaukee.

Power-Transmission Mchy.

Allis-Chalmers Co., Milwaukee.
H. W. Caldwell & Son Co., Chicago.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Hayward Co., The, New York.
Jeffrey Mfg. Co., Columbus.
Link-Belt Co., Phila.
Mead-Morrison Mfg. Co., Boston.
Mecklenburg Iron Wks., Charlotte, N. C.
Morse Chain Co., Trumansburg, N. Y.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison.
Philadelphia Drying Mchy. Co., Phila.
Platt Iron Works Co., Dayton.
Robins Conveying Belt Co., N. Y.
Sprague Electric Co., New York.
Webster Mfg. Co., Chicago.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.
R. D. Wood & Co., Phila.

Presses and Dies.

Curtis & Curtis Co., Bridgeport.
Niagara Mch. & Tool Wks., Buffalo.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Watson-Stillman Co., New York.
R. D. Wood & Co., Phila.

Production Engineers.

Gunn, Richards & Co., New York.
Stephen T. Williams, New York.
Sullivan Machinery Co., Chicago.

Prospecting Drills.

Am. Diamond Rock Drill Co., N. Y.
Ingersoll-Rand Co., New York.
Keystone Driller Co., Beaver Falls, Pa.
Star Drilling Machine Co., Akron, O.

Pulleys, Shafting & Hangers.

Allis-Chalmers Co., Milwaukee.
Am. Tool & Machine Co., Boston.
H. W. Caldwell & Sons Co., Chicago.
Fay & Egan Co., Cincinnati.
Jeffrey Mfg. Co., Columbus.
Poole Eng'g & Mch. Co., Baltimore.
Robins Conveying Belt Co., N. Y.

Pulverizing Mill.

W. D. Dunning, Syracuse.
Lehigh Car, Wheel & Axle Works, Catasauqua, Pa.
F. L. Smidth & Co., New York.
Sturtevant Mill Co., Boston.
Vulcan Iron Works, Wilkes-Barre, Pa.

Pump Governors.

Albany Steam Trap Co., Albany.
Mason Regulator Co., Boston.
Strong, Carlisle & Hammond Co., Cleveland.
Williams Gauge Co., Pittsburg.

Pumps and Pumping Mchy.

Albany Steam Trap Co., Albany.
Alberger Condenser Co., New York.
Allis-Chalmers Co., Milwaukee.
Ashcroft Mfg. Co., New York.
Geo. F. Blake Mfg. Co., New York.
Bucyrus Co., So. Milwaukee.
Buffalo Forge Co., Buffalo.
Cameron Steam Pump Wks., N. Y.
Clayton Air Compress. Wks., N. Y.
I. R. Davis & Son, Hartford.
Deane Steam Pump Co., New York.
De La Val Steam Turbine Co., Trenton.
Emerson Steam Pump Co., Alexandria, Va.
Epping-Carpenter Co., Pittsburg.
Flint & Walling Mfg. Co., Kendallville, Ind.
Goulds Mfg. Co., Seneca Falls, N. Y.
Guild & Garrison, Brooklyn.
Hall Steam Pump Co., Pittsburg.
Holly Mfg. Co., New York.
Ingersoll-Rand Co., New York.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
Lawrence Mch. Co., Lawrence, Mass.
Lawrence Pump & Engine Co., Lawrence, Mass.
John H. McGowan Co., Cincinnati.
Mecklenburg Iron Wks., Charlotte, N. C.
Morris Mch. Wks., Baldwinsville, N. Y.
Platt Iron Works Co., Dayton.
Providence Eng'g Wks., Providence.
Snow Steam Pump Wks., New York.
Southwark Fdy. & Mch. Co., Phila.
E. W. Vanduzen Co., Cincinnati.
Watson-Stillman Co., New York.
Robt. Wetherill & Co., Chester, Pa.
Wheeler Condenser& Eng'g Co., N. Y.
R. D. Wood & Co., Phila.
Henry R. Worthington, New York.

Pumps, Syphon.

Chaplin-Fulton Mfg. Co., Pittsburgh.

Punching & Shearing Mchy.

Bethlehem Fdy. & Mch. Co., So. Bethlehem, Pa.
Morgan Construction Co., Worcester.
National Machinery Co., Tiffin, O.
Niagara Mch. & Tool Wks., Buffalo.
Niles-Bement-Pond Co, New York.
Pratt & Whitney Co., Hartford, Conn.
Williams, White & Co., Moline.
R. D. Wood & Co., Phila.

Pyrometers.

Edward Brown & Son, Philadelphia.
Queen & Co., Philadelphia.

Quarry Machinery.

S. Flory Mfg. Co., Bangor, Pa.
Ingersoll-Rand Co., New York.
Lambert Hoist. Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
John H. McGowan Co., Cincinnati.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.
Star Drilling Machine Co., Akron, O.
Sullivan Machinery Co., Chicago.
Trenton Iron Co., Trenton.

Racks—Machine Cut.

Wm. Gauschow, Chicago.
R. D. Nuttall Co., Pittsburg.

Rail Braces.

Rail Joint Co., New York.

Rail Joints.

Rail Joint Co., New York.

Railway Shop Machinery.

W. F. & J. Barnes Co., Rockford, Ill.
Clayton Air Compress. Wks., N. Y.
Fay & Egan Co., Cincinnati.
Ingersoll-Rand Co., New York.
Laidlaw-Dunn-Gordon Co., New York.
National Machinery Co., Tiffin, Ohio.
Niles-Bement-Pond Co., New York.
Norwalk Iron Wks., So. Norwalk, Ct.
Pratt & Whitney Co., Hartford.
Stow Flexible Shaft Co., Phila.
Stow Mfg. Co., Binghamton, N. Y.
H. B. Underwood & Co., Phila.
Watson-Stillman Co., New York.
Williams, White & Co., Moline.

Rawhide Gears.

New Process Raw Hide Co., Syracuse.
William Gauschow, Chicago.

Reamers.

Chicago Pneumatic Tool Co., Chicago.
Ingersoll-Rand Co., New York.
Pratt & Whitney Co., Hartford.

Reinforced Concrete Steel.

Electric Welding Mfg. Co., Pittsburg.

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Resistance Banks and Units.
Elec. Controller & Supply Co., Cleveland.

Rheostats.
Simplex Elec. Heat. Co., Cambridge, Mass.

Riveting Machines.
Bethlehem Fdy. & Mch. Co., So. Bethlehem, Pa.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
William Sellers Co., Inc., Phila.
R. D. Wood & Co., Phila.

Rivet-Making Machinery.
National Machinery Co., Tiffin, O.

Rock Breakers.
Allis-Chalmers Co., Milwaukee.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.

Rolling Lift Bridges.
Cowing Engineering Co., Cleveland.
Scherzer Rolling Life Bridge Co., Chicago.

Rolling Mill Machinery.
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
Morgan Const. Co., Worcester.
Niles-Bement-Pond Co., New York.
Poole Eng. & Mach. Co., Baltimore.
Robt. Wetherill & Co., Chester, Pa.

Roofing.
Am. Bangor Slate Co., Easton, Pa.
Bangor Excelsior Slate Co., Easton, Pa.
Barber Asphalt Paving Co., Phila.
Barrett Mfg. Co., New York.
J. A. & W. Bird & Co., Boston.
Genuine Bangor Slate Co., Easton, Pa.
J. S. Moyer & Co., Bethlehem, Pa.

Roofing Paints
National Paint Works, Williamsport, Pa., and New York.

Roofing Tin.
Am. Sheet & Tin Plate Co., Pittsburg.

Roofing Slate.
Am. Bangor Slate Co., Easton, Pa.
Bangor Excelsior Slate Co., Easton, Pa.
Genuine Bangor Slate Co., Easton, Pa.
Keenan Structural Slate Co., Easton, Pa.
J. S. Moyer & Co., Bethlehem, Pa.

Rope.
American Mfg. Co., New York.

Rope Transmission.
American Mfg. Co., New York.
H. W. Caldwell & Son Co., Chicago.
C. W. Hunt Co., New York.
Jeffery Mfg. Co., Columbus.
Link-Belt Co., Phila.
Providence Eng'g Wks., Providence.

Rubber Goods.
Boston Belting Co., Boston.
Jenkins Bros., New York.

Sand Mixers and Sifters.
S. Obermayer Co., Cincinnati.

Sash Operating Device.
Lord & Burnham Co., New York.

Saw-Mill Machinery.
Allis-Chalmers Co., Chicago.
Curtis & Co., Mfg. Co., St. Louis.
Fay & Egan, Cincinnati.
Jeffrey Mfg. Co., Columbus.

Saws, Hack.
Diamond Saw & Stamping Works, Buffalo.
Niles-Bement-Pond Co., New York.

Scales.
Buffalo Scale Co., Buffalo.
Fairbanks Co., New York.
Richardson Scale Co., New York.

Screens, Mining.
Allis-Chalmers Co., Milwaukee.
Jeffrey Mfg. Co., Columbus.
Robins Conveying Belt Co., N. Y.
W. S. Tyler Co., Cleveland.

Screens, Rolled Slot.
Allis-Chalmers Co., Milwaukee.
W. S. Tyler Co., Cleveland.

Screw Machines.
Jones & Lamson Mch. Co., Springfield, Vt.
National-Acme Mfg. Co., Cleveland.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

Separators, Steam and Oil.
Allis-Chalmers Co., Milwaukee.
American District Steam Co., Lockport, N. Y.
American Tool & Mch. Co., Boston.
Austin Separator Co., Syracuse.
John Davis Co., Chicago.
Julian D'Este Co., Boston.
Direct Separator Co., Syracuse.
Goubert Mfg. Co., New York.
Harrison Safety Boiler Wks., Phila.
Hoppes Mfg. Co., Springfield, O.
Potter Separator Co., Newburgh, N. Y.
Warren, Webster & Co., Camden N. J.
Watson & McDaniel Co., Phila.

Shaft Couplings, Flexible.
Elec. Controller & Supply Co., Cleveland.

Shapers.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

Shop Lamps, Gas.
General Gas Light Co., Kalamazoo, Mich.

Shutters (Fire).
Kinnear Mfg. Co., Columbus.

Slate.
Am. Bangor Slate Co., Easton, Pa.
Bangor Excelsior Slate Co., Easton, Pa.
Genuine Bangor Slate Co., Easton, Pa.
Keenan Structural Slate Co., Easton, Pa.
J. S. Moyer & Co., Bethlehem, Pa.
Pennsylvania Structural Slate Co. Easton Pa.

Speed Controllers.
Foster Engineering Co., Newark.

Spike Machines.
National Machinery Co. Tiffin, Ohio.

Spiral Gears.
R. D. Nuttall Co., Pittsburg.

Stacks.
The Petroleum Iron Works Co., Washington, Pa.

Stamps — Steel, Alphabets and Figures.
Schwerdtle Stamp Co., Bridgeport.

Stand Pipes.
Electric Welding Mfg. Co., Pittsburg.
Struthers-Wells Co., Warren, Pa.
The Petroleum Iron Works Co., Washington, Pa.
Tippet & Wood, Phillipsburg, Pa.
Walsh's Boiler Wks., Holyoke, Mass.

Steam Engine Indicators.
American Steam Gauge & Valve Mfg. Co., Boston.
Ed. Brown & Son, Philadelphia, Pa.
Star Brass Mfg. Co., Boston.

Steam Jet Pumps.
E. W. Vanduzen Co., Cincinnati.

Steam-Regulat'g Appliances.
Albany Steam Trap Co., Albany.
Am. Steam Gauge & Valve Co., Boston.
Ashcroft Mfg. Co., New York.
Crane Co., Chicago.
Julian D'Este Co., Boston, Mass.
Foster Engineering Co., Newark.
Harrison Safety Boiler Wks., Phila.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati.
Mason Regulator Co., Boston.
Pittsburg Gage & Supply Co., Pittsburg.
Pittsburgh Valve & Fittings Co., Pittsburgh.
Power Specialty Co., New York.
Walworth Mfg. Co., Boston.
Watson & McDaniel Co., Phila.
Williams Gauge Co., Pittsburg.
D. T. Williams Valve Co., Cincinnati

Steam Shovels.
Allis-Chalmers Co., Milwaukee.
Bucyrus Co., Milwaukee.
C. W. Hunt Co., New York.
Marion Steam Shovel Co., Marion, O.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., New York

Steam Traps.
Albany Steam Trap Co., Albany.
American Blower Co., Detroit.
American District Steam Co., Lockport, N. Y.
Ashcroft Mfg. Co., N. Y.
Geo. F. Blake Mfg. Co., New York.
Chaplin-Fulton Mfg. Co., Pittsburgh.
Julian D'Este Company, Boston.
Strong, Carlisle & Hammond Co., Cleveland.
B. F. Sturtevant Co., Hyde Park, Mass.
Walworth Mfg. Co., Boston
Watson & McDaniel Co., Phila
D. T. Williams Valve Co., Cincinnati
Williams Gauge Co., Pittsburg.
Wright Mfg. Co., Detroit.

Steam Fitters' Supplies.
American District Steam Co., Lockport N. Y.

Steel.
Wm. Jessop & Sons New York.
Walworth Mfg. Co., Boston.

Steel Balls.
American Ball Co., Providence,
U. S. Cast Iron Pipe & Fdy. Co., Phila.
R. D. Wood & Co., Phila

Steel Concrete Construction.
Berlin Construction Co., Berlin Conn.
Miller-Collins Co., New York.
Ransome & Smith Co., N. Y.
Trussed Concrete Steel Co., Detroit.
Turner Construction Co., New York.

Steel, High Speed.
Wm. Jessop & Sons New York.

Steel, Reinforced Concrete.
Electric Welding Mfg. Co., Pittsburg.

Steel Sheet Piling.
U. S. Steel Piling Co., Chicago.

Stencils.
Schwerdtle Stamp Co., Bridgeport.

Stokers—Mechanical.
Babcock & Wilcox Co., New York.
Under-Feed Stoker Co., Chicago.
Westinghouse Mch. Co., Pittsburg.

Strainers.
Emerson Steam Pump Co., Alexandria, Va.

Structural Iron Works.
Berlin Construction Co., Berlin, Conn.
Miller-Collins Co., New York.
Ransome & Smith Co., N. Y.
Riter-Conley Mfg. Co., Pittsburg.
Wm. B. Scaife & Sons Co., Pittsburg.
Turner Construction Co., New York.

Structural Paint.
U. S. Paint Co., Williamsport, Pa.

Structural Slate.
Am. Bangor Slate Co., Easton, Pa.
Bangor Excelsior Slate Co., Easton, Pa.
Genuine Bangor Slate Co., Easton, Pa.
Keenan Structural Slate Co., Easton, Pa.
J. S. Moyer & Co., Bethlehem, Pa.
Pennsylvania Structural Slate Co., Easton, Pa.

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Sugar-House Machinery.
Am. Tool & Mch. Co., Boston.
Geo. F. Blake Mfg. Co., New York.

Superheaters.
Babcock & Wilcox Co., New York.
National Superheater Co., New York.
Power Specialty Co., New York.
Providence Eng'g Wks., Providence.

Suspension Bunkers.
A. Samuel Berquist, Brooklyn.

Switchboards.
C & C Electric Co., New York.
Western Electric Co., Chicago.

Tackle Blocks.
Lane Bros. Co., Poughkeepsie, N. Y.

Tanks.
Atlantic Works, East Boston, Mass.
East Jersey Pipe Co., New York.
L. O. Koven & Bro., New York.
Mecklenburg Iron Wks., Charlotte, N. C.
Riter-Conley Mfg. Co., Pittsburg.
Wm. B. Scaife & Sons Co., Pittsburg.
Struthers-Wells Co., Warren, Pa.
Tippett & Wood, Phillipsburg, Pa.
Walsh's Boiler Wks., Holyoke, Mass.
Robt. Wetherill & Co., Chester, Pa.

Taps and Dies.
Crane Co., Chicago.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford.

Tapes, Measuring.
Kolesch & Co., New York.
Lufkin Rule Co., Saginaw, Mich.

Telephones.
Stromberg-Carlson Tel. Mfg. Co., Rochester.

Tenoning Machines.
Fay & Egan Co., Cincinnati.

Thermometers.
Bristol Co., Waterbury.
Hohmann & Maurer Mfg. Co., Rochester.

Time Checks.
Am. Ry. Supply Co., New York.
Schwerdtle Stamp Co., Bridgeport.

Time Stamps and Recorders, Automatic and Portable.
Perry Time Stamp Co., Chicago.

Tin, Roofing.
Am. Sheet & Tin Plate Co., Pittsburg.

Tracing Cloth.
Kolesch & Co., New York.

Traveling Link Grates.
Green Engineering Co., Chicago.

Trolleys.
Maris Bros., Philadelphia.

Trucks, Commercial.
Electric Vehicle Co., Hartford.
Knox Motor Truck Co., Springfield, Mass.

Tumbling Mills.
S. Obermayer Co., Cincinnati.

Turbines, Steam.
Allis-Chalmers Co., Milwauke.
De La Val Steam Turbine Co., Trenton.
General Electric Co., Schenectady.
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Tippet & Wood, Phillipsburg, Pa.

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Turret Lathes.
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Jones & Lamson Mch. Co., Springfield, Vt.
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Pratt & Whitney Co., Hartford.

Twist Drills.
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Underground Conduit Systems.
G. M. Gest, New York.

Upsetting Machinery.
National Machinery Co., Tiffin, Ohio.
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Bristol Co., Waterbury, Con.
Hohmann & Maurer Mfg. Co., Rochester.

Vacuum Pumps.
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Clayton Air-Compres. Wks., N. Y.
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Guild & Garrison, Brooklyn.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
John H. McGowan Co., Cincinnati.
Platt Iron Works, Dayton, Ohio.
Snow Steam Pump Wks., New York.
Wheeler Condenser & Eng'g Co., N.Y.
Henry R. Worthington, New York.

Valves, Foot.
Emerson Steam Pump Co., Alexandria, Va.

Valves—Gas, Steam & Water.
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Am. Steam Gauge & Valve Mfg. Co., Boston.
Ashton Valve Co., Boston.
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Chapman Valve Mfg. Co., Indian Orchard, Mass.
Chaplin-Fulton Mfg. Co., Pittsburgh.
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Hancock Inspirator Co., N. Y.
John Davis Co., Chicago.
Julian D'Este Co., Boston.
Foster Eng'g Co., Newark.
Jenkins Bros., New York.
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Lunkenheimer Co., Cincinnati.
Manning, Maxwell & Moore, N. Y.
Mason Regulator Co., Boston.
Pittsburg Valve, Fdy. & Cons. Co., Pittsburg.
Ross Valve Co., Troy.
Star Brass Mfg. Co., Boston.
Walworth Mfg. Co., Boston.
Watson & McDaniel Co., Phila.

Valves, Reducing.
D. T. Williams Valve Co., Cincinnati.
Mason Regulator Co., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

Ventilating Apparatus.
B. F. Sturtevant Co., Hyde Park, Mass.
Western Electric Co., Chicago.

Voltmeters.
Western Electric Co., Chicago.
Weston Elec. Instrument Co., Waverly Park, Newark.

Wagons, Dump.
Troy Wagon Works Co., Troy, Ohio.

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National Machinery Co., Tiffin, Ohio.

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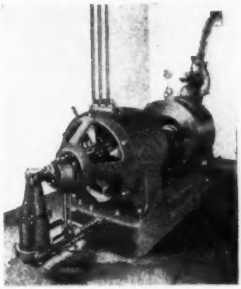

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THE Editors of THE ENGINEERING MAGAZINE have much pleasure in announcing a series of timely and very valuable special articles beginning with the current number, and being a continuation of the notable publications which the Magazine has been presenting during the past ten years, covering every practical problem in the management and mechanical equipment of modern engineering plants.

Regular readers of the Magazine will recall that beginning in the Spring of 1896 with a striking article entitled "The Destructive Use of Machine Tools"—a description of the driving all-night and all-day work at the Baldwin Locomotive Works in Philadelphia—this was immediately followed by a suggestive and valuable series of papers on "Machine Shop Management and Equipment," by Horace L. Arnold, H. F. L. Orcutt, Samuel M. Vauclain, and a dozen other writers of like varied and practical experience.

The interest aroused by these early publications was so widespread and genuine, and they brought so many requests for further information concerning special lines of work, that the discussion quickly and steadily broadened until it has included mechanical equipment in all its branches, economy and efficiency of the modern power plant, the wages system in comparison with piece-rate and the premium plan of remunerating labor, cost-keeping and factory accounting, costs in contract work and mining operations, the discipline and management of employees—in short the literature of the modern system of Highly Specialized Production, which has enormously increased output, decreased labor costs, and widened all the margins of profit for machinery builders, manufacturers, contractors, and producers generally.

The Literature of Engineering Management

In this ten-year period, therefore, we have not only created and published a literature of modern engineering management—every portion of which is still in daily demand at our offices—but beyond that, every established engineering journal in the world has found it necessary to take up the discussion which THE ENGINEERING MAGAZINE inaugurated, and they have published hundreds of valuable special articles, supplementing our own. Scores of kindred papers have also been presented and discussed at the meetings of the great engineering societies on both sides of the Atlantic, and at least a dozen excellent books of lasting value on cost-keeping, factory accounting, management, etc., have been published, and two monthly publications, *System* and the *Selling Magazine*, give their whole attention to special departments of these important subjects.

New and Important Publications

All of this is very gratifying. It shows that ten years ago we found a mine of needed information—a broad vein which is still yielding rich ore. The subject is still weighty with interest and importance, and we have had ten years of experence in selecting topics for discussion and authors competent to treat them. And because the definite aim is to have practical men write for practical men—to present "working plans" available for immediate use—we take special pleasure in commending to the attention of Engineers, Superintendents and Managers the new series of important publications announced on the following pages. A glance at these headings and brief outlines will show plainly that all the subjects are of present and practical importance, that many invaluable suggestions are certain to be presented, and hence that during the coming half year the Magazine will carry unusual interest for practical men who are studying the newer problems of management and mechanical equipment.

The opening paper in each series appears in this number, and the discussion will continue throughout the coming Autumn and Winter.

WAKE UP, AMERICA! Manufacturing Methods Which Now Begin to Threaten Trade

By DR. LOUIS BELL

Making things by the mile, and then sawing them into lengths, is a wonderfully successful temporary expedient—but dangerous in the long run. A system of specialized machinery and methods which at one stage forced America to the front, is now beginning to show faults and points of weakness. The cost of changing the product in any way becomes enormous, and the lead in making improvements passes to the few who have unlimited capital, or to manufacturers elsewhere whose generalized system, by its greater elasticity, makes change and improvement so much the easier. Submitting striking evidence from recent comparisons with European mechanical practice, Dr. Bell is able to teach a timely lesson which every American manufacturer should now heed.

The Simplification of Shop Systems By A. W. THOMPSON

Supplementing Dr. Bell's admirable paper, Mr. Thompson's discussion is an excellent one to offer to manufacturers who have been surfeited with system until they find its burdens

almost greater than its benefits. He proposes sane, simple methods, which are almost self-operating, and furnishes the few clear forms necessary to put them into effect. It is not a theoretical proposition, but a description of the things actually done and proved to be successful in the large shops managed by the author.

Money-Making Possibilities of Patents By E. J. PRINDLE

The great fortunes won from patented inventions are before every one's eyes. Rich opportunities of like kind may be lying unseen, within any one's grasp, their money-making value unrealized and undeveloped, because of ignorance of the exact steps needed to protect and exploit them—ignorance even that they can be patented and given an immense market value.

Mr. Prindle is a practical mechanical engineer as well as a most successful patent lawyer. He has had entire charge of patenting, litigating, and triumphantly establishing the claims of some of the most widely known recent inventions. He does not undertake in these articles to make every manufacturer his own lawyer. He does point out a whole range of generally unknown possibilities for profitable patents—in the shop, in relations with employees, in the sales office. He suggests many chances for pre-empting new markets or entering desirable ones. And his explanations are so clear and his suggestions so full that no manufacturer need be in doubt how to proceed to follow out any line that looks promising.

I—The Influence of Patents in Commanding Success

The Value of Patents in Creating a Great Business—Their Part in Controlling a Market—Living Examples—How it Was Done—What is Patentable—The Nature of a Patent—The Claims of a Patent—Fundamental Principles in the Drawing of Claims.

II—What Protection a Patent Affords

Making, Using and Selling—Domestic Manufacture for Use Abroad—Importation of Patented Devices—Injunctions and Damages—Restrictions as to Price, Territory, Numbers and Uses of Patented Articles—Repair and Improvement of Patented Devices—Interpretation of the Claim of a Patent—Infringement by Improvements—By Structures not within the Terms of Claim but Equivalent Thereto.

III—Patent Knowledge Needed Before Issuing a New Product

Would its Manufacture, Use, or Sale Infringe Other Patents?—If so, How Can the Situation be Met?—Can the Product be Protected by Patents?—Should it be thus Protected?—Various Ways of Obtaining a Monopoly of a Product.

IV—The Patent Relations of Employer and Employee

The Right of the Employer to Use the Inventions of his Employees—The Ownership of Patents on Employees' Inventions—Contracts with Employees for Future Inventions—The Employer's Use of Employees to Carry Out Inventions Conceived by Himself.

Designing the Power Plant By A. E. DIXON

The engineer who writes under the name of "A. E. Dixon" has for many years been intimately connected with power-plant design, construction, and operation. He writes as an insider, in view not merely of "all the conditions which can be foreseen and calculated, which is theory; but of all the conditions there are, which is practice." He treats with the utmost frankness and impartiality the peculiar and sometimes unforeseen questions which arise through the often opposing interests of owner, architect, engineer, contractor, and superintendent. His discussion is full of valuable hints based on the experience gained in existing installations, and of suggestions which might be made highly profitable to the man in charge of the work or the man who is providing and erecting the buildings or the machinery.

The illustrations will be especially good—many in number and genuine in value, as they will be drawn from the latest and best practice and the most successful installations on either side of the Atlantic.

An introductory article appears in the August number of THE ENGINEERING MAGAZINE. The first illustrated paper of the series is published in the September issue, and the following sections, dealing with each of the important mechanical features in turn, will be issued consecutively month by month thereafter.

I—The Location of Plant and Handling of Fuel

The Location of the Plant—Water Supply—The Fuel Question—Fuel Storage—Loss by Storage—Unloading—Spontaneous Combustion and its Prevention—Handling and Transporting Plant—Coal Handling in the Power House—Bunkers—Conveyors, Crushers, Hoists, etc.

II—Boilers, Grates, Stokers and Chimneys

Types of Boilers—Large Boilers; their Advantages—Boiler Settings—Faults and Advantages of Marine-Type Setting—Grates and Stokers—Divided Fireboxes—Firebrick Work—Chimney Construction—Brick and Steel—Smoke Flues.

III—Natural and Mechanical Draft

The Combustion of Fuel—Chimney and Flue Losses—Burning Fuel to Advantage—Flue Gases—Losses due to Incomplete Combustion—Continuous Analysis—Draft Regulators.

IV—Water Supply and Purification

Impurities in Water and their Results—Their Removal—Open and Closed Heaters and Economizers.

V—Main and Auxiliary Machinery

Turbines, Horizontal and Vertical—Reciprocation Engines—Steam Economy—Superheat—Condensers—Vacuum Pumps—Circulating Pumps—Electrically-Driven Auxiliaries—Steam-Driven Auxiliaries.

VI—Gas Engines and Gas Generators

Two and Four-Cycle Machines—Oil and Gasolene Engines—Coke-Oven Gas—Producer Gas—Water Gas—Bench or Coal Gas—Suction Gas Producers—By-Products.

Reorganizing the Railway Shop By H. W. JACOBS

Because the railway shop is not competitive—because it does not have to study expenses closely so as to undersell a rival manufacturing a similar product—it has been slow to adopt the methods of shop betterment and works organization which have been almost universally adopted into manufacturing concerns.

Lately, however, the close scrutiny of operating expenses has roused the mechanical departments of our railways to a keen and most active study of the best ideas and methods adaptable to the railway machine shop. The new movement is full of interest and importance, not only to the man in charge of motive power and equipment, or of the shops themselves or any department of them, but also to the manufacturer of modern tools and materials. It has opened new opportunities for men and machinery already in many of the larger railroads, and it will inevitably extend rapidly to all, large and small.

Mr. Jacobs is one of the men who has made the greatest success in carrying out this work. He is engaged in it now, for one of the largest transcontinental railways. He does not speculate as to what might be done, but tells what has been done, how it was done, and what profits resulted. And the pictures bring the actual work of the shop, and the practical improvements, directly before the eye of the reader.

I—The Demand for Higher Economy in Railway Shops

Special Character of the Railway Shop—How Far General Organization Methods are Applicable—Notable Instances—The Question of Salaries—Centralizing the Shop Work—Stores-Room Records—The Value of Figures.

II—The General Aspects of Standardization

Methods of Standardization—The Practice of Four Great Railway Systems—Standard Specifications for Parts—Parts Interchangeable for all Types—Standard Tools for Special Parts—Gradual Replacement of Non-Standard Machinery—A Policy Outlined—Sub-Stores—Difficulties with Foremen—Departmental Conferences—Directing the Shopping of Engines—The Possible Savings.

III—Ruling Considerations in Shop Betterment

Redesign of Patterns—Study of Metal Supply—Centralizing Foundry Work—The Blacksmith Shop—Balancing the Machine—Tool Equipment—The Personal Equation of Master Mechanics—Danger of Over-Equipment—General Inventory of Tools—Transfer and Redistribution—Introduction of Alloy Steel—Comparative Performances Described and Illustrated—Supervision of the Tool Account—Selection and Design of Tools—Adaptation and Rebuilding of Old Machines—The Theory of Machine-Tool Economy—Shafting and Belting—Examples of Redesign.

IV—Standardizing the Small-Tool Equipment

The Purchase of Steel—Examples of Standard Tools—How Adapted to Air Tools—To Boiler Shop, Erecting Shop—Bench-Economies to be Expected—Alloy-Steel Tools—Where to Use Them—Custody and Supervision—How to Keep Down Investment—Functions of the Tool Room—Its Operating Force—Its Limits.

V—Erecting-Shop Economies

The Introduction of Standards—Useful and Profitable Devices—Miscellaneous Economies—Systematizing of Jobs—Shop-Order Manufacturing—Office Systems—Checks on

the Payroll—Reward for Individual Effort—Premium and Bonus Systems—Education and Publicity.

Revival of the Apprenticeship System By O. M. BECKER

The development of the jig, the rig, and the special machine has resulted in practically eliminating the highly skilled workman from the manufacturing shop. His place is taken by the piece worker, who has learned one small part only in the scheme of production, and does this part over and over, mechanically.

But this very system, employing specialized and automatic tools, causes on the other hand a constantly rising demand for high-class machinists, capable of building and maintaining these machines and of directing the men who operate them. This demand, for some years past, has outrun the supply, in spite of an influx of men from abroad, trained under the old school and there, too, the old school is passing away.

What is to take its place? Where are the all-round mechanics to come from, since the shop is no longer, as of old, a sufficient training ground?

Some few large establishments in the United States have approached the answer to these questions by establishing apprentice systems to operate as training schools, raising up young men qualified to fill the needs of their own shops. In the belief of many able managers, the solution for the country at large lies in extending this policy and adapting it to meet the conditions of the average shop.

Mr. Becker, after careful study of methods and practical experience in applying them, proposes a system which can be conformed to the needs of any ordinary establishment. His article is not merely descriptive; it is constructive. He built up a working plan, formed from the best elements obtainable and based on practical knowledge of results. It is founded on facts so broad and solid that it will win the confidence of managers generally.

A Practical Method of Obtaining Foundry Costs By C. J. REDDING

Mr. Redding's declared purpose is "to illustrate a method by which all estimating is eliminated from foundry costs." He describes a system by which "the actual cost of each casting can be obtained without any guesswork at all." As a result of the introduction of the system, "several foundries have increased their output from 5 to 15 per cent., and this without any great expense."

Copies of the various orders and other forms are given, but as the author says, "these can be altered to suit the requirements of each shop. The principle is the chief thing, and so long as accurate results are obtained, the details are of no great importance and can be modified to suit special or individual cases."

The system is applicable to brass as well as to iron foundries.

Mr. Redding's method is to follow the work regularly through the foundry, beginning with the receipt of the order in the office and proceeding from the drawing to the pattern shop, and to the foundry floor. Every detail of time and material charges, and all ordinary contingencies and emergencies, are recognized and provided for. The forms and blanks are introduced as they would naturally be called for in the work, and the use of each, and the daily routine of practice connected with it, are explained in logical order.

In view of the backward condition of foundry casting generally, and of the serious commercial difficulties which may arise from mistakes due to general averaging, a practical, economical method of gaining accurate figures is extremely important, and will be most welcome to foundry and shop managers everywhere.

Cement-Making Machinery for a Modern Mill By F. H. LEWIS

The first of two articles reviewing concisely the mechanical equipment of the modern cement-plant in the light of the best-accepted practice. The enormous increase in the use of concrete in structural work has partly occasioned, and in return has largely been made possible by, the improvement of mechanical appliances and processes in cement manufacture. The author is an expert in this particular field. His initial article takes up kilns or other roasting machinery, and the concluding one will deal with grinding and separating machinery. Both will be fully illustrated with plans, drawings and photographs of existing plants.

The Mechanical Uses of Water Under Pressure By WILLIAM M. BARR

This paper covers a field in which the author has long been recognized as a leading specialist—that of the various devices for utilizing hydraulic power, which of late years have found new favor and a wide range of usefulness in hoists, presses, punching and shearing machinery, hydraulic jacks, accumulators, water motors, etc. The article, both in its text and illustrations, will bring to notice many forms of apparatus which may profitably be examined and considered by those in charge of mechanical processes and manufacturing establishments.

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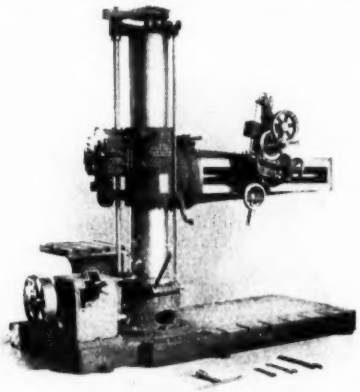

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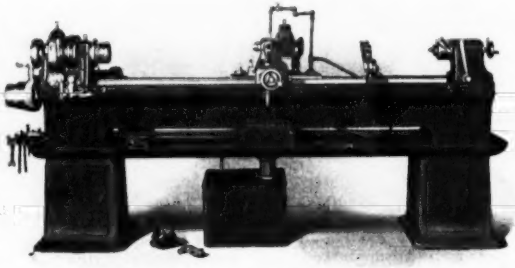

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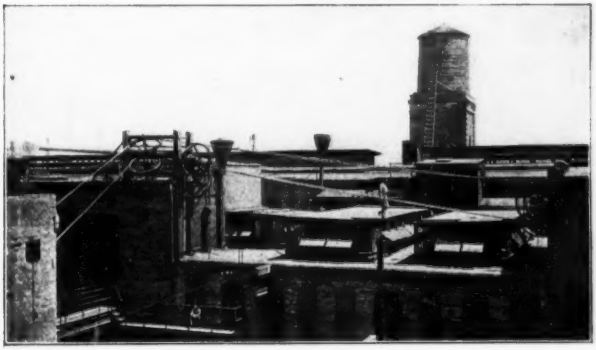

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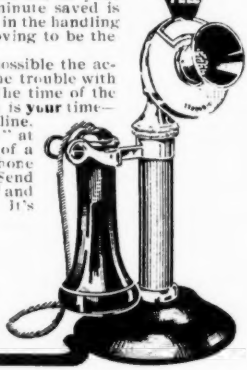

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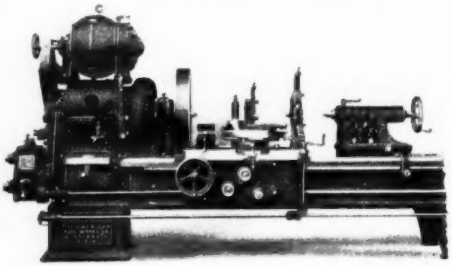

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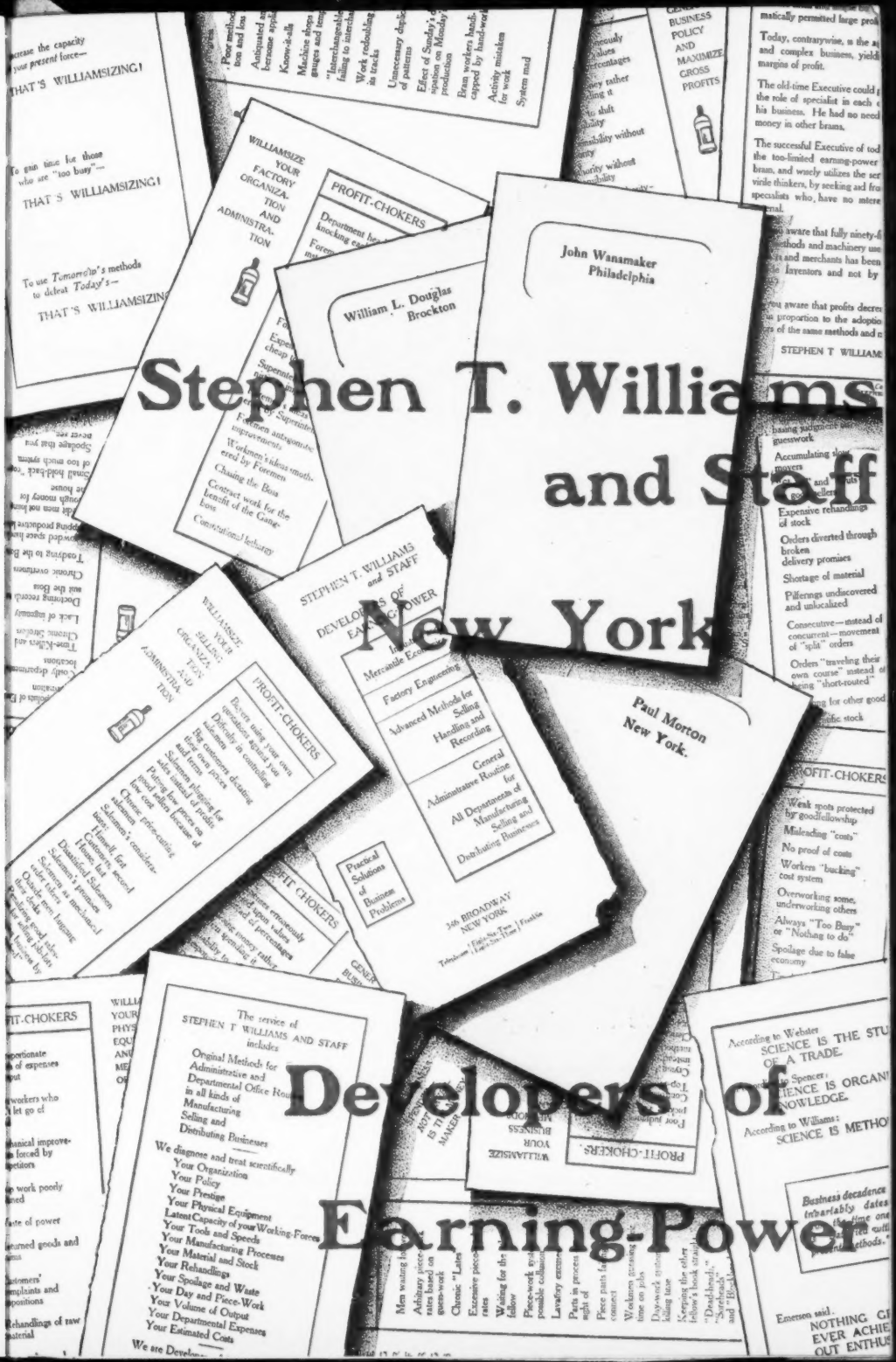
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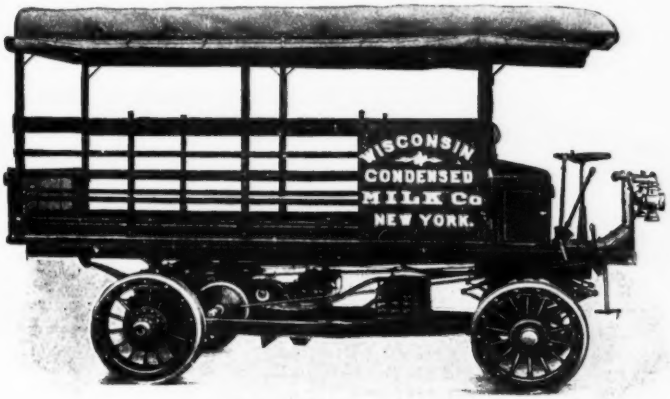

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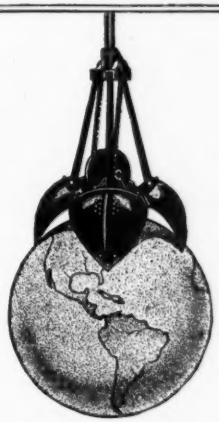

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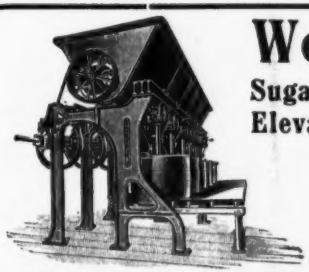

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